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THUNDER-STORMS.

A TYPICAL thunder-storm is first seen as a dense, ragged cloud in the west, extending to a height of over a mile. The sky is entirely clear elsewhere, except sometimes covered by a light fleecy veil of cirrus. The cloud in the west rapidly enlarges, and completely covers the sky except a small portion to the east and south-east. The motion of these clouds is distinctly from the west and quite rapid, while the surface wind is from the south and quite gentle. This wind is blowing toward a general storm situated about five hundred miles to the north-west, and has no connection at all with the thunder-storm which is suddenly interjected, as it were, upon the quiet air. Often there are seen two clouds in the south-west and north-west which seem to meet together and produce the storm, but more often the first appearance is that of a great cloud of dust borne upward about three hundred feet, and advancing with great rapidity from the west (sometimes eighty miles per hour). Some of the clouds sprinkle a little rain as the dust-cloud advances, but this is very light. When the storm is very severe, a loud roar is heard like the continuous discharge of electricity which produces a steady instead of intermittent thunder. During this time, lightning-flashes are seen and distant thunder heard. In a few moments, after the dust-cloud has approached nearer and practically with it, the wind suddenly whirls to the west, and blows with great velocity (sometimes eighty miles per hour). Then, in a moment or two more, the lightning and thunder become very intense, and rain falls in torrents. Often the lightning's flash is the signal for a fresh downpour, allowing a few seconds for the fall of the rain from its height. This phenomenon has led to the view, now almost universally accepted, that there is a most intimate relation of cause and effect in this display of electricity and the subsequent rain. Under some circumstances, but invariably in connection with this heavy rain, there fall hail-stones variously measured from the size of a pea to that of hen's eggs, and even larger. In some cases, larger masses, even as great as an elephant, have been reported, but these are due to a mingling or freezing together of many stones in the air or after they reach the earth.

Cold Air.

During the progress of a thunder-storm, and after its front has reached the observer, there is a remarkable cooling of the air. This cooling seems to arise from a downward current in the centre of the storm. It cannot be due to the onrush of a north-westerly wind, for that must come from a warm region, since the thunder-storm has been suddenly interjected into a region of warm southerly winds flowing for hundreds of miles toward the north. This cooling is often very great, and seems to indicate that the air in the centre of the storm is not abnormally heated, as in the case of a general storm, but is very much cooled. The bearing of this upon the generation of the thunder-storm is of great importance, and does not seem to have been sufficiently considered.

Environment.

When the storm passes to the north or south of the observer, there is quite a brisk breeze from it, showing that the motion of the air is from it on at least three sides. Often it is possible to view the storm, in its onward progress, with clear sky overhead, if its border does not reach the zenith of the observer. Under these circumstances, one sees very distinctly up to the highest clouds a steady motion to the east. The rain is seen falling in great sheets, and its front is very distinctly marked. This rain front seems to be an important phenomenon, and has been seen scores of times advancing with a slight lagging at the earth and in the clouds. The appearance impresses one at once as caused by a rapid motion in the middle cloud region, with a lagging at the earth possibly from friction, and in the upper part of the cloud from a less velocity at that point. In no instance has there ever been observed an uprush of air anywhere in this region. These storms go in parallel lines; and as many as four have been seen running one behind the other, the most northerly one in advance. Often it is reported that a storm has gone slightly north of a station, and then turned and come back directly over it; but this is probably an illusion. The second storm has a motion the same as the first, but goes a little farther south. The motion across the country of these storms is about double that of the attending general storm to the north-west.

Probably the most marked characteristic of a thunder-storm, however, is a rise in pressure at its centre. This rise is universally conceded to-day, though its cause is in grave doubt. It has been repeatedly observed in storms where there has been no rain, and hence cannot be due to the cooling of the air by the rain, or to its downward pressure as it falls. How is it possible to account for this rise of pressure in a storm which is itself travelling more than a mile a minute? We have here to consider a phenomenon entirely distinct from a sand-whirl of the desert, which has only a slight progressive motion. There seems to be no doubt whatever that we are to consider here a cause or a condition which is inherent in the storm itself. There can be no upsetting of the equilibrium, no uprush of air just in front of a thunder-storm and nowhere else, which could give such a rise of pressure in so rapidly a moving body of air. We are cer-

tainly dealing here with a *plenum* which moves with the storm, and in fact is the storm itself. It may not be that this is due to a downrush of air-particles from some height; but there is no serious difficulty in assuming that, through electrical action, there is an increased pressure in the centre. It is plain that the foregoing description has a most marked parallelism with that already given of the tornado, and it is virtually admitted that a tornado is simply an extreme development of a thunder-storm.

The attempt to show that while these phenomena are alike in most respects, and yet that in one of the more important factors they are entirely distinct, is most remarkable. We are taught that the origin of both is an unstable equilibrium, in both there is an uprush of air, in both there is a cloud of dust, in both there appear to be two clouds meeting from the north-west and south-west, in both there is a loud roar heard oftentimes, and in both there is a pronounced cooling. They are exactly alike, and produced the same way, but the final result of these actions is to develop two entirely dissimilar and almost opposite conditions. We are told that in a thunder-storm the air starts upward in the centre, has its moisture condensed by expansion, and the resulting precipitation cools the air, increases its density, and finally the diminished pressure at starting gives way to an increased pressure from this change in the density. It must be admitted that this is a reasonable conception, and may be true; but would not this at once destroy the ascending current, and bring the whole action to a standstill? Can we for a moment have both uprushing currents in a storm-centre feeding its energy, side by side with downrushing currents increasing the pressure? It is only necessary to state this contradiction in order to show the absurdity of the hypothesis. This theory strikes at the root of the whole process of liberation of energy in a moist ascending current; but, more than that, if there is such a cooling and subsequent downrush, why should it not act in precisely the same manner in a tornado? How is it possible for this same uprushing current, which starts in exactly the same way in both these conditions, to continue upward in a tornado, to gather energy as it rises, to liberate more and more latent heat, to rush faster and faster, to grow warmer and warmer, and finally to produce the violent tornado with its supposed almost perfect vacuum in the centre, where a half-mile away there is perhaps a thunder-storm causing an increase of pressure? It would seem as though there could hardly be a plainer exposition of the utter futility of all the attempts that modern theorists have made to grapple with this problem than this latest attempt to start the thunder-storm and tornado in the same direction, and finally bring them out, from almost the same conditions, facing in opposite directions, and absolutely dissimilar in their most essential characteristic.

Explosive Effects.

Is it possible for electricity to produce a sudden increase of pressure in a mass of air sufficient to violently rend asunder objects which it strikes? Oftentimes the bark of trees has been driven off; and the usual explanation of this has been, that the heat of the electricity has converted the sap into steam, and this in turn has forced off the bark. This, however, is not satisfactory, for the reason that even a dead and perfectly dry tree has been struck, and scattered over a large field. A remarkable instance of explosive action in a lightning discharge is to be found in *Nature* for May 8, 1890. A tree standing in a rather open field was struck by lightning, and its fragments strewed over two acres of ground. One solid piece weighing five pounds and a half was thrown three hundred and seventy-eight feet. Other *débris* lay two hundred and ten feet in another direction. Small pieces of riven trunk and bark were found thrown in the teeth of the wind and one hundred and eighty feet from the tree. The concussion or increase of pressure smashed six fine glass window-panes in a house not far away. Another very interesting effect was noted in a house that was struck in Washington, D.C., Aug. 23, 1885. In this case the lightning struck the south-west corner of the tin roof on an ell built on the south side of the house, and divided. A portion of the flash passed down an eaves-spout; and at its end, which was two or three feet above the ground, it passed through the air to the damp side of the house, knocking off the plastering on the inside. The other portion of the flash passed down between the weather-boarding and the plastering on the east side, shattered one of the upright posts, and appeared to explode off the weather-boarding toward the east, and the plastering toward the west. A woman and her two sons were apparently stunned by the effects.

While such cases have usually been regarded as "freaks" of lightning, yet it would seem that the matter has not been sufficiently studied to enable us to determine just what effect such a discharge would have upon a confined air space. It may be, the apparent bursting of a house in a tornado may be accounted for in this way. An instance has already been given at St. Louis of a rise in pressure, as shown by a barograph, and at the same time a seeming bursting of houses. Hardly a month passes that there is not some discovery regarding this extraordinary force of electricity, and surely we are not in a position to deny that it might not produce a large number of effects now observed in a tornado, such as searing of green leaves, discoloring the trunks of trees, increasing the pressure, exploding houses, depluming fowls, etc. We are told that lightning-flashes are seldom seen in a funnel-cloud. They have been seen there many times. Moreover, it is not at all certain that an ordinary observer would be in a condition to take particular notice of the presence of electricity in a tornado; and, again, the electricity may pass down or up the funnel without a visible flash. The presence of ozone has been often noticed in a tornado where no lightning was seen.

Possibilities of Electric Action.

It has been my purpose for many years to avoid, as much as possible, all speculations in considering air motions and the causes of atmospheric phenomena. This is especially pertinent when we consider electric action in the atmosphere. It is very difficult to believe that electricity has nothing to do with our thunder-storms, and is merely a result, and never a cause. The fact that physicists have never yet been able to account for more than the smallest fraction of atmospheric electricity should lead us to greater diligence in determining its methods. We know from observation that the electric potential is enormously increased as we ascend in the atmosphere. That little or no connection between atmospheric electricity and storms has been observed

by our instruments near the earth is not remarkable, since the earth and air just above it may neutralize all electric action for a hundred feet or more. Our thunder-storms seem to show an enormous storehouse of electricity at five thousand or six thousand feet above the earth; at least, electricity seems to be concentrated there over thousands of square miles during thunder-storm action. We are taught that electricity forms a sort of dual condition, or the electric field is a double one. May not this electric field draw on the sun for its energy? It is believed that light, heat, and electricity are all different manifestations of the same radiant energy. The abundant source of this energy is the sun. Why may not the sun's electricity, oftentimes observed by its direct effect on our magnetic instruments, and more often still indirectly in our auroras, be intercepted by a peculiar condition of the atmosphere or of the earth below, and thus be concentrated in particular localities? Generally this electricity passes through the air to the earth, but must we think that it always does so? May not this electric field or dual condition gradually develop in the atmosphere largely independent of the passage of air-particles through wind or convection currents?

The Electric Field.

For convenience it has been generally considered that particles have a tendency to leave the positive and pass to the negative pole. For example: in the electric arc-light the carbon at the negative pole is built up at the expense of the positive. The velocity of transmission of these carbon particles perhaps cannot be determined, but it must be only a very small fraction of that of electricity, 190,000 miles per second. Is there any inherent improbability in the supposition that in this dual condition in the atmosphere there is a tendency for moisture and possibly dust particles, positively electrified, to pass rather rapidly from the positive pole, or, better, positive portion of the electric field, to the negative portion? We know from observation that during the passage of a high area or clear sky the electric potential, with very few exceptions, becomes markedly positive, while during the fall of rain it is negative. While a thunder-storm is passing, there are most violent fluctuations of the electrometer-needle from negative to positive and back again, as each flash of lightning is noticed. These fluctuations of the needle are perhaps a hundred times as great as under ordinary conditions of rainfall, and take place when the flash is a mile or two away, showing a most extraordinary inductive action upon the atmosphere, and for enormous distances. We have positive evidence of such transmission of moisture-particles by a force entirely distinct from heat, pressure, or any other commonly recognized meteorologic condition. It is known that the moisture in the air is one of the most constant elements we have to deal with. The temperature may rise and fall thirty or forty degrees during the day, and yet the quantity of vapor is in no wise changed. The wind, either in direction or velocity, does not change this moisture. The hiding of the sun's heat or light in no wise affects it. Changes in air-pressure produce no effect in general. As a storm approaches, however, we find a most marked increase in this moisture over thousands of square miles, and this even in a calm. As a storm passes off, the conditions are sharply reversed. The moisture becomes depleted in a most remarkable manner, as though it were actually drawn out of the atmosphere by an invisible agency.

The most remarkable example of such action was observed on Dec. 22, 1889, from a third-story window of a house in Washington. It will be seen that the conditions were not favorable for observing this effect at its best. At 3.11 P.M. there were 4.09 grains per cubic foot, and for more than twenty-four hours previous there had been an abundance of moisture from a storm passing near by. The air was almost a calm, and continued so till nigntfall. At 5.2 P.M., or one hundred and eleven minutes later, there was only 1.04 grain per cubic foot, and this continued as long as observed. To any one who has made determinations of the moisture of the air, and noted its great constancy, frequently for several days, this sudden subtraction must be very extraordinary. If such changes are possible near the earth, and in the centre of a large city with houses for more than a mile on all sides, what may we not expect to take place in the free air, where there are no interferences, and where we know that such forces are acting in far greater intensity than near the earth?

Enormous Fall of Rain.

Just after a thunder-storm or tornado, there are torrents of rain, and in some quarters it is getting to be quite the custom to call such phenomena cloud-bursts. In these cloud-bursts almost an incalculable amount of rain falls, more than a foot having been reported at times. In one case four feet of hail were reported. Just how much territory is covered by such a cloud-burst cannot be told, as the data are not sufficiently numerous, but fifty or sixty square miles may be easily considered. We have already seen that the later theory, which calls for a downrush in the centre of a thunder-storm, effectually disposes of all possibility of this enormous amount of moisture rushing up in the centre and being condensed by expansion. In the case of a tornado, it is incredible that even a thousandth part of this moisture can be carried up in a funnel a few hundred feet in diameter. If we inquire what would be the effect of the ordinary condensation of such a mass of water in the air over such a limited space, we are confronted by an amount of heat set free that is simply appalling. One gallon of rainfall gives out sufficient heat to melt forty-five pounds of cast iron. A very little consideration will show us that it is absolutely impossible, even allowing a current of moist air at any conceivable velocity, for even a small fraction of rain to be precipitated out of such a current. It has already been shown that the latent heat set free would at once re-evaporate the moisture. We seem to be driven to invoke the aid of some other agent than any thus far recognized as cogent in producing our storms. Is it inconceivable that we have to deal here with a negative electric field, which draws to itself with great velocity particles of moisture from regions perhaps for one hundred miles about, when suddenly, upon a discharge of electricity, the potential upon the particles is diminished, and they unite in great abundance and form raindrops? This is a most inviting field for observation. We already have facts enough to make a plausible hypothesis, and, what is very important, we have here an unlimited amount of energy which may be called upon to produce all the effects ever observed.

It is not a little remarkable that the earlier views all ascribed tornadic action to electricity, and it would seem as though the time were not far distant when we would be forced to return to this agent for explaining the phenomena. What are needed are careful experiments in this most enchanting field of research. An attempt has been already made to test the question of the transmittal of moisture through the air by electric action. A Holtz machine was run for fifteen minutes in a rather large room; and most careful measurements of the amount of moisture at the machine and at a point twenty feet away, before and after the machine was in action, showed an increase at the machine. When we consider that it was impossible to measure the moisture contents just at the plate of the machine, and also what an extremely slight charge could by any possibility enter the air from the machine, we can but be surprised that any effect at all was observed. With improved methods of observation by which the exact hygrometric state of the air can be easily and accurately determined, and with very accurate tables of reduction which we now have, all that is required is an observer for investigating these phenomena. The expense for apparatus need not be great.

H. A. Hazen.

CUSTOMS OF COURTESY.[1]

Few ceremonial customs have originated in recent times. Their forms, whether now trivial or still important in sociology, are vestiges of the past, and only by anthropologic studies are traceable to their genesis and early form. All authorities, unswayed by a religious or theorizing bias, agree that in the origin of these ceremonies there was nothing designed or intentional; that is, they were not directly invented with definite purposes. A thing is not now and never has been customarily done because it is intrinsically right, but is considered to be right after and because it has been habitually done, whatever its origin or the circumstances in which it prevailed.

The rules of courteous behavior as they now exist are not the immediate effect of deliberate conventions, but are the natural and slow product of the forces gradually developing social life, and they exhibit the laws of evolution with as great distinctness as is demonstrated in the physical realm. Men have not fabricated though they have framed rules for themselves. They have fallen into the customs from which rules were framed, and then by unintended modifications have deviated into novelty and new rules.

To the query "Why do nations and peoples do any thing as a custom?" the optimist answers, "Because it is right;" which assumption yet further confuses the vexed question whether, in the nature of things, there is an absolute right and an absolute wrong; for customs vary even unto opposition in different parts of the world, and not only in different, but in the same, periods of history; so that they cannot all be absolutely right. In matters large and small, vital and trivial, what is esteemed as virtue and merit at one place and time, is condemned at others as vice and crime. Explanation has been attempted on the theory, that, there being distinct races of men, each of them has its idiosyncrasy; indeed, that by primordial decree each of them had the mission to do certain things, and no others. By such theory, fatalism is omnipotent, and all men are marionettes. But this explanation depends upon a conceded classification of men into races, which has failed. A few years ago, school-boys glibly recited the titles of the races of men, with their characteristics; but now students who have devoted long lives to the subject find such classification to be so difficult that no two writers agree. This does not indicate the proposition that there are no distinct races of men; indeed, it is possible that once there were many more races than have ever been recognized, the present condition being one of amalgamation. But the plot of the marionette show becomes confused when there is no agreement about its personages.

The chief justice of a high court lately declared that no race of men was good for any thing which had not believed in only one God, and allowed only one wife. As all the races of men have at some time believed in many gods, and have allowed a plurality of wives, this dictum would condemn all; but it is an example of hysteron proteron, or "the cart before the horse." If the statement had been that polytheism and polygamy were outgrown before the attainment of high culture, it would have been historically true; but as made, it is as inaccurate as to assert that no race is good for any thing in which the men have not always worn trousers,—a useful but recent invention of civilization. Instead of seeking an explanation of customs in race, it is more practical, as well as more scientific, to look for it in habitat and history; i.e., in environment.

An apparent exception occurs in the arbitrary edicts of fashion, styled very properly by Borachio as "a deformed thief;" but a distinction may readily be made between custom and fashion. Fashion is imitation and transitory. It is most commonly noticed in details of dress or ornament designed by some influential person to conceal a defect or display a beauty; sometimes, however, in latter days, by a conspiracy of manufacturers, tailors, or milliners. With the cessation of the special influence, the imitation gradually declines, unless, indeed, genuine merits are discerned in the invention, in which case it is assimilated through the vital catalysine faculty. The method of human progress is empirical. The good and useful, when ascertained by experiment, are retained for further improvement throughout the ages, while the nocuous or useless are sooner or later rejected.

The views submitted dissent, though meekly, from some details in the work of that great writer and thinker, Herbert Spencer. No one can deny his comprehensive grasp of intellect, his brilliance of style, and his wealth of illustration, but more especially the wonderful and far reaching suggestiveness by which he has awakened and guided modern thought. Yet he is more beneficent as an educator of the mind than as an instructor in facts. In particular, his most admiring student must lament the Zoroastrian phantasy or dual antagonism of good and evil that mystifies his principles of sociology. To him militancy is Ahriman, and industrialism is Ormuzd, and their conflict is forced to explain all the myriad problems of human life. But the known causes and effects are too numerous and diverse to be disposed of by one universal solvent. The complex knots must be patiently untied, and cannot be severed by the rusty sword of a vamped and varnished Parsee dualism. Nor does history confirm this prosopopœia of good and evil. Industrialism began very early, and among the most cultured nations is now in a high state of development; yet it exhibits within itself strife and turmoil, selfishness and cruelty, equal to all the similar crimes ever charged against militancy. The latter has by no means passed away, though the human race has surely advanced. In fact, an evolutionary advance is manifest in militancy itself parallel with that seen in other lines of thought and action. Militancy, therefore, is not the cacodemon by whose overthrow alone the world has grown better.

The verbal forms of salutation may be divided into (1) those of a purely religious character, (2) those equivalent to a prayer for the health and temporal good of the person saluted, (3) those simply wishing health and prosperity without direct invocation of a deity, and (4) those expressing personal or official affection or respect.

1. The Israelites, both in meeting and parting, used a word meaning "blessing," and the person addressed was thereby commended to God. The expressions "Blessed be thou of the Lord!" and "The Lord be with thee!" are traditional.

The Arabian often says, "God grant thee his favors!" also "Thank God! how are you?" and the Turk, "My prayers are for thee," or "Forget me not in thy prayers." In Poland a visitor to a house will cry out, "The Lord be praised!" to which the hostess will answer, "World without end, amen!" The "sweet girl

[1] Abstract of the leading article in the American Anthropologist for July, 1890, by Garrick Mallery.

graduates" of conventual schools in this country involuntarily answer a knock at their doors by the word "Toujours!" instead of "Come in!" through the habit formed when the sister at the convent dormitory door uses a formula in praise of the Virgin Mary, to which the obligatory response was, "Forever!" Very lately a similar custom prevailed throughout Spain by which the visitor ejaculated "Maria purissima!" the reply being "Sin pecado concebida!" On other occasions the Spaniards say, "Vaya con Dios!" ("Go with God!") In the Tyrol, people exchange the formula "Praised be Jesus Christ!" and the Neapolitans, that of "Increase in holiness!"

2. The forms of greeting that pray for the health and well-being of the friend addressed are distributed generally. Indeed, our term "salutation" is derived from the Latin *salus*, and similar etymologies are found in other languages. The Ottoman cries, "Be under the guard of God!" In Arabia, on the first meeting of the day, the proper phrase is, "May God strengthen your morning!" or "May your morning be good!" The Persian begins his polite address with "I make prayers for thy greatness." The return to a salutation in the Orient is sometimes not only religious, but non-committal. If an Arab is directly asked about his health, he responds, "Praise be to God!" leaving his condition to be inferred from the modulation of his voice. If the form of the query is, "Is it well with thee?" the answer is, "God bless and preserve thee!" The Zuñi exchange the prayer, "May the light of the gods rest with thee!"

3. The general wish for health and prosperity, of which the English "farewell" as distinguished from "good-by" is an example, is often only implied in the query showing interest as to their present possession. The Arabs reiterate the query "How are you?" for some minutes, and, when well brought up, afterwards interrupt the subject of the conversation by again interjecting "How are you?" many times. Our "How d'you do?" has almost lost significance, as it is seldom answered except by reproduction, no one supposing it to be a *bona-fide* request for information. Many other salutations, abroad as well as at home,—e.g., "Good-morning!" "Hot day!" "Cold day!" or other meteorologic comments,—are now mere watchwords or countersigns, to indicate that the parties meeting are on good terms. Indeed, the origin of many old forms is the distinct declaration of peace, which was practically useful in the turbulent days when an enemy was more frequently met than a friend. This "passing the time of day" is now common at the occasional meeting of good-natured persons, by which the inane words form the friendly recognition of one of the same race.

The North American Indians do not have many conventional forms of salutation. Their etiquette generally is to meet in silence, and smoke before speaking, the smoking being the real salutation. But a number of tribes—i.e., the Shoshoni, Caddo, and Arikara—use a word or sound very similar to "How!" but in proper literation "Hau!" or "Hao!" Most of the Sioux use the same sound in communication with the whites, from which the error has arisen that they have caught up and abbreviated the "How are you?" of the latter. But the word is ancient, used in councils, and means "good," or "satisfactory." It is a response as well as an address or salutation.

An interesting point in this connection is the objection of some peoples to being praised for flourishing health, which is never admitted. For instance: to the Cingalese the expression "You look well," or "You have become stout," is very annoying, the reason being that the notice of malign deities would be attracted to their fortunate condition, upon which it would be destroyed. This illustrates the old story of the jealous gods, and the power of evil being the most important deity, and recalls many classic fables, among others that of the ring of Polycrates, in several lands and languages.

That this dread survives among some of the peasantry of Europe appears in their invariable refusal to respond that they are perfectly well, and a similar superstition has recently been reported from the mountains of North Carolina. The Chinese, in greeting, not only depreciate their own status, but exaggerate that of the party of the other part. The established ritual averages thus: "How is the excellent health enjoyed by your wealthy and accomplished highness, and that of the brilliant full moon his spouse, and of the strong lions his sons, and graceful gazelles his daughters?" The obligatory response would be, "The ignorant beggar whom your benevolence deigns to notice is in his usual condition of dirt and disease, and the sow his wife, and pigs his offspring, starve in their old filthy sty." Perhaps the elegant expressions of response by cultured persons in absolute health, "Quite well, thank you!" "Passably," "About the same," and the like, considered to be a polite avoidance of boasting, have their origin in high antiquity.

Persons of general intelligence in the most civilized nations yet show relics of the dread of demons when an epidemic prevails. It was lately noticeable in Washington that the response about freedom from the grippe generally contained some qualification,—"Haven't got it yet," or the like.

The wish of salute is often specific, connected with the circumstances of environment. The people of Cairo anxiously ask, "How do you perspire?" a dry skin being the symptom of the dreaded fever. In hot Persia the friendly wish is expressed, "May God cool your age!" that is, give you comfort in declining years. In the same land originates the quaint form, "May your shadow never be less!" which does not apply, as often now used in Europe, especially in Ireland, to the size and plumpness of the body as indicating robust health, but to deprecate exposure to the noon sun, when all shadows are least.

The Genoese, in their time of prosperity, used the form "Health and gain!" In some of the Polynesian isles the prayer for coolness is carried into action, it being the highest politeness to fling a jar of water over a friend's head. According to Humboldt, the morning salute on the Orinoco is, "How have the mosquitoes used you?"

The old religious views of the Persians are found in their wishes, "Live forever!" and (still retained in Spain) "May you live a thousand years!" They believed only in this life, and that through divine favor it might be unlimited.

4. The terms of affection in greeting are too numerous to be now recited. The following are mentioned as unhackneyed and of interest. Some Orientals say, "Thou hast made me desolate by thine absence from me;" and the ordinary form of greeting among the Zulus is simply, "I see you, and I am glad."

The variant phrases of respect are also multitudinous. Perhaps the most distinct form in which the common and ancient expression of the East, "I am your slave," survives in western Europe is in the Piedmont district of Italy. The Spaniards, through the influence of Moors and Jews, have many relics of Orientalism. It becomes colloquial in the form Usted contracted from "Veustra merced;" 'your mercy," "your grace." often appearing in the phrase "I kiss my hands to your grace."

But the forms of respect and subservience, more than those of affection, have become established into titles of honor and nobility, therefore can be presented with some defined system not boundless as are the epithets poured from the ardent imaginings of friends and lovers.

It is not, however, possible now to attack the grandiose division of human vanity to which Selden alone devoted one thousand printed folio pages. Perhaps the only civil title of ceremony, as distinct from official designation, legally existing in this country, is that of esquire, which has almost fallen into disuse, being chiefly employed by attorneys-at-law. But they have a right to it. An esquire was originally an attendant on a knight; but later in England the title was given to all officers of the crown, which included attorneys, who are officers of the courts. Hence the English jest of the last century, that attorneys were only "gentlemen by act of Parliament." Such acts, being in force in our colonial period, applied to attorneys here, also officers of court.

"Sir," which has ceased to be a title in becoming the general form of address, has been generally derived directly from "sieur," the abbreviation of "seigneur," implying the lordship of land so essential to the feudal system that the legal maxim ran, "Point de terre sans seigneur;" but the derivation of "sieur" and "sire" was from the same root, originally signifying "senior," i.e., "elder," with the synonyme of "father." The form "sire" ante-

ceded that of "sieur;" and undoubtedly the term of respect involving the concept of "elder" and "father" long preceded the ownership of land. Terms of rank and gradation founded on seniority and paternity are fundamental in the sociology of the North American Indians, prevailed among the founders of Rome, and, as terms of respectful address, are still common in Asia and eastern Europe. Therefore, when you address a man as "sir," you etymologically imply that he is your father.

The subject of titles in the United States presents some amusing features. The Constitution prohibits titles of nobility; and of course the people insist upon all other kinds of titles, thereby proving the accuracy of the Roman poet's oft-quoted lines about the futility of casting out nature with a pitch-fork. Not only does a day's possession of any office baptize the possessor with a title for the remainder of his life, but often official or professional titles are bestowed in taste or discretion; so that "colonel," "judge," and "doctor" only imply some peculiarity in form, manner, or clothing. In this multiplicity and plethora it is strange that some men confer titles upon themselves without authority, as it is far more dignified and distinguished not to bear or allow any. This is not on the principle, often too broadly asserted, that "the post of honor is the private station," but because all titles of honor and distinction are degraded by misuse; e.g , that of "professor," now the perquisite of balloonists and jugglers. But there can be no argument with a superstition. The best treatment of the folly would be that advocated to settle the liquor question,—by high license and strict inspection. Let every man take what title he may choose, but pay for the privilege. The result would be that either the craving would diminish or the revenue increase from the taxation of a useless luxury, either of which is a desideratum.

All relations to addresses, titles, and ceremonial visits involve the assertion of, contention for, and regulation of, precedence. These are of immemorial antiquity, being traceable to the principle of the struggle for existence and survival of the fittest, and have diminished with the decreased operation of that principle among men, not with the discontinuance of militancy. The extent of the surviving attention to precedence in England, as gathered from the mere literature on the subject, would be misleading. In the heraldic catalogues there are eighty-nine distinct sets of men above the rank of a burgess, who have their specified places in processions and even at ceremonious dinner-parties, but every-day life is little affected thereby; always, however, remembering Thackeray's dictum, that an "Englishman does love a lord." As regards ceremonies at dinner-parties, the compliment of being served first has its disadvantages. Unless the guest thus distinguished exhibits greediness, the food placed before him will become either too cold or too warm before the others of the company can be ready. This is another case where the mean is golden.

The most illustrative notes on precedence appear in diplomatic history. Once at the court of France the envoys of Genoa and Brandenburg, being unable to agree as to which should present himself first to the king, stipulated that whichever first reached the palace on the day appointed should have the precedence. The prudent Prussian sought to make himself safe by sitting down on a bench in the hall of the palace all the night before; but the treacherous Italian, arriving near the proper hour, and seeing his adversary half asleep on the bench, slipped by into the royal bedroom. Precedence must be maintained for mere dignity, without any direct object: so two ambassadors who met face to face on the bridge at Prague were obliged to stop there for the entire day because neither of them would disgrace his country by letting the other pass.

In cases of milder action it was usual to stipulate, by previous arrangement, for absolute and exact equality in every detail. This was the plan pursued when Mazarin and Don Louis de Haro met to settle the conditions of the marriage between Louis XIV. and Maria Theresa. The two ministers stepped together, with the right foot, side by side, into a council-chamber hung in corresponding halves with their respective colors, and sat down at the same instant precisely opposite each other at a critically square table on two mathematically equivalent arm-chairs.

The last connected chapter of Macaulay's "History" shows amusingly the waste of time and energy in which Kaunitz and Harlay watched one another's legs at the Congress of Ryswick, lest a priority in muscular action should jeopardize, as it did delay, the peace of two continents. One of the most stupidly arrogant assertions of precedence was made by Napoleon in 1808. The Almanach de Gotha had just been printed for that year with the regular alphabetical arrangement of the reigning houses, beginning with the Anhalt duchies; but the parvenu emperor suppressed the edition, and required the whole to be printed with his name in the first page.

"Giving" or "taking the wall" in passing, so frequently alluded to in Shakspeare and other authors of his time as an indication of rank, had tangible loss or advantage; as in the narrow and crowded street, destitute of sidewalks, proximity to the wall was safer and more convenient. But the same precedence on entering or leaving a room or passing through a doorway was contended for in vanity and pretension. A happy example of the modern politeness in which, both in form and fact, egotism has yielded to altruism, is in the rivalry, now so frequently shown, when two men accidentally meet at a door or other passage, by which each presses the other to advance, thus showing a survival in reverse of the old contention for precedence.

Upon a general summary of the whole subject of salutation, it is obvious that it was once a serious tax upon time. Both in the Old and New Testament injunction was given, whenever expedition was required, "to salute no man by the way." The minute, tedious, and verbose politeness of the East was an insuperable impediment to rapid travel; and this is still the case among such people as the Araucanians, whose formalities of meeting and greeting occupy at least a quarter of an hour.

The greatest abbreviation of such forms appears among the most cultured of modern peoples, and is directly in the evolutionary line of utility through saving of time; but it has still further significance. The forms of ancient peoples and of existing savages and barbarians show intention to accomplish something definite by the special act of salutation. They are generally limited to classes and individuals, are sometimes with petition for or in declaration of peace, are made in personal placation, or are the exchange of supplications to whatever deities or demons may be credited with power. Cultured people do not now regard these objects to be appropriately connected with salutations of courtesy. They now use a brief, nearly meaningless formula almost indiscriminately, so that it has no special relation to the persons saluting and saluted or to their respective status. It is the recognition by one human being of another, and is the best mark of real culture, its absence characterizing the savage or the boor. Its spirit is found in Talfourd's lines:—

> "It is a little thing to speak a phrase
> Of common comfort, which by daily use
> Has almost lost its sense; yet . . . 'twill fall
> Like choicest music . . .
> To him who else were lonely, that another
> Of the great family is near and feels."

But it is not a little thing that a simple, kind recognition from man to man, even if often perfunctory, should replace the terms of elaborate egoism and stupid superstition. It is a sign of the evolution in which

> "Love took up the harp of Life, and . . .
> Smote the chord of Self, that, trembling, passed in music
> out of sight."

NOTES AND NEWS.

IN January of the present year two samples of compressed or tablet tea were presented to the Museum of the Royal Gardens, Kew, by Col. Alexander Moncrieff. In the new number of the *Kew Bulletin* the letter with which these samples were accompanied is printed, and much interesting information as to the making of compressed tea is brought together. Repeated attempts have been made to introduce compressed tea into this country, but never with complete success. "A few years ago," says the

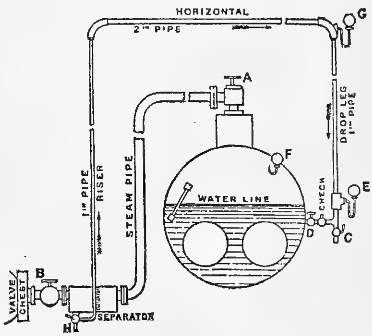
Kew Bulletin, "two companies were formed for working it; and at the present time there is a company in London which deals exclusively in this article, a sample of which is in the Kew Museums. It is claimed for this tea that it has many advantages over loose tea, the chief of which is, that, the leaves being submitted to heavy hydraulic pressure, all the cells are broken, and the constituents of the leaf more easily extracted by the boiling water, thus effecting a considerable saving in the quantity required for use. Its great advantages over loose tea, however, would seem to be its more portable character; and in the case of long sea-voyages, or for use in expeditions, the reduction of its bulk to one-third. The compression of tea into blocks, further, it is said, constitutes a real and important improvement in the treatment of tea. These blocks weigh a quarter of a pound each, and are subdivided into ounces, half-ounces, and quarter-ounces. This insures exactitude in measuring, and saves the trouble, waste, and uncertainty of measuring by spoonfuls. It also insures uniformity in the strength of the infusion. By compression it is claimed that the aromatic properties of the leaf are retained for a much longer period, and that it is better preserved from damp and climatic changes."

—In accordance with an agreement between the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, the headquarters of the Institute of Electrical Engineers will hereafter be at the house of the Mechanical Engineers, 12 West 31st Street, near Fifth Avenue. Communications and exchanges should be addressed accordingly.

—A paper on the Mannesmann weldless tubes was lately read before the Society of Arts, London, by Mr. J. G. Gordon, the chair being occupied by Sir Frederick Bramwell, who referred to the importance and interest of the subject, and to the extraordinary means by which the desired result was attained. The process, according to *Nature*, consists in the solution of a purely kinematical problem; viz., the arranging of the velocity ratio of a pair of aconoidal rolls so as to change a solid piece delivered to them at one end into a hollow tube passed out at the other. These rolls revolve at about 200 to 300 revolutions per minute, and, by their action on the hot and therefore plastic steel, stretch it, and make a hollow in the centre. The substance of the metal must be sufficiently homogeneous and plastic; and in passing through the rolls it undergoes a violent twisting and stretching action. The bar, in fact, in its passage through the rolls, is twisted as a thread is twisted in a spinning-machine, the material being drawn from the interior. This action was illustrated by one of the exhibits, which consisted of a bar, the ends of which were slightly drawn down under the hammer, so that the rolls could not act on them. A hollow was thus produced in the solid bar of metal, the contents of which were tested by Professor Finke of Berlin, and found to contain 99 per cent of hydrogen of its total volume. The remaining 1 per cent he considered to be probably nitrogen. In the carrying-out of the process, 2,000 to 10,000 horse-power is required for from 30 to 45 seconds, according to the dimensions of the tube. Although this is all the time actually required to convert a bar 10 to 12 feet long and 4 inches in diameter into a tube, a certain amount of time is required to adjust the guides, to deliver the bar to the rolls, and to remove the finished tube. The time so spent is employed to accumulate energy in a fly-wheel 20 feet in diameter, weighing 70 tons, and revolving 240 times in a minute, the periphery of which, therefore, revolves at 2.85 miles per minute. By this means a steam-engine of 1,200 horse-power is quite sufficient to do the work. A peculiar feature of these rolls is that the resulting tube is a test of the material and process. If the metal is homogeneous throughout, and well melted, well rolled, and carefully heated, it makes a perfect tube; but if there is a flaw in the metal, or if it has not been properly heated, the rolls cannot make a tube out of it. The paper, which was illustrated by photographs of the mills and engines, led to a very interesting discussion, in which Sir Frederick Bramwell, Professor A. B. W. Kennedy, Mr. Alexander Siemens, and others, took part.

—In France much interest is being taken in the question whether a university shall be established in Paris. At a meeting of the general council of the Paris faculties, held June 14 at the Sarbonne, it was agreed that a university with five faculties (Protestant theology, law, medicine, science, and literature), and an upper school of pharmacy, should be formed. "The principal effects of the constitution of the university," says the Paris correspondent of the London *Times*, "will be to permit the faculties to make arrangements for the organization of instruction (under the form of schools or institutes), of which the elements are at present scattered in several faculties, and to facilitate a sort of general instruction of a philosophical character, to which the professors of all the faculties will contribute, and which will be addressed to the students. The university will grant, besides professional degrees, diplomas of purely scientific studies to native and foreign students."

—The steam-loop is an appliance for returning to a steam-boiler the condensed water from steam-pipes, jackets, heating-coils, and the like. It is a striking piece of apparatus, since it will return water to a boiler situated at a higher level, without the intervention of pumps, injectors, or other motors. The water, according to *Engineering*, simply flows back just as if it were under the action of gravity, the only means of communication being a range of pipes. The action will be readily understood by reference to the annexed diagram, which shows a steam-boiler connected by a steam-pipe from the dome *A* to a steam-engine *B*. Immediately in front of the engine is fixed a separator, which catches the water carried over by the steam, as well as that which condenses in the pipe. From the bottom of the separator there rises a pipe until



it attains a considerable elevation above the water-line of the boiler; it then proceeds horizontally, and finally descends, and enters the boiler at *D*. The water from the separator follows the course of the pipe, and flows into the boiler at a higher level than the separator. The reason of this will be readily seen. The steam-pipe and the steam-loop are both connected to the boiler; but of course there is a slight difference of pressure in them, the pressure falling a little the farther the steam gets from the boiler. Let us suppose the pipes to be blown through at the cocks *H* and *C*, and these cocks then closed. Water will commence to collect in the separator, and the pressure in the loop to fall by reason of condensation. The excess of pressure in the separator will immediately begin to drive the water up the riser, not in a solid body, but in separate plugs or plungers, which will follow each other at frequent intervals. As soon as these reach the top of the riser, they will flow along the horizontal pipe, which is of large diameter, and collect in the down pipe. Here the mass will remain until the head of water, plus the steam-pressure above it, is sufficient to raise the check-valve, when a part of the column will flow into the boiler. Usually a head of a few feet is sufficient to effect this; but, if the pipes be very long, it may require twenty feet or more. At the moment when the check-valve lifts, the gauges at *E* and *F* will give the same reading, while the gauge at *G* will show the steam-pressure existing at that point. The water is thus returned to the boiler without loss of pressure, and almost without loss of heat. This is done continuously and automatically, the only care required being to blow though occasionally to remove the air.

SCIENCE:

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

VOL. XVI. NEW YORK, JULY 4, 1890. No. 387.

CONTENTS:

GEORGE HAMMELL COOK.[1]

"YET once more, O ye laurels, and once more
Ye myrtles brown, with ivy never sere,
I come to pluck your berries harsh and crude,
And with forced fingers rude
Shatter your leaves before the mellowing year.
Bitter constraint and sad occasion dear
Compel me to disturb your season due."

ONE by one the great men depart. As they pass from the sphere of personal association through the portal of the grave into the world of immortal influence, their deeds and honors are recounted by those who remain.

When the last entry has been made, the book is opened, the account is rendered. Blessed is he whose good deeds more than balance his emoluments, whose services to mankind more than equal the honors paid him by mankind, for "it is more blessed to give than to receive." Thrice blessed is the man whose life and services we commemorate to-day.

The generation now at the zenith of life succeeds a generation whose zenith was clouded by war. As the great men of that day pass out through the sunset of life, their battle-deeds are told. It is thus that the mortuary ceremonies of this generation echo the clangor of charging squadrons, the shrieking rattle of battle-lines, and the roar of batteries.

Sequestered from the pomp of parade, from the roar of funeral gun, from the battle cemetery that hides under marble columns the victims of battle strife, here in the peaceful halls of learning we assemble to commemorate the life of a man whose ways were "paths of peace," whose chariot of progress through the world bore no scythe of destruction, whose life was wholly beneficent, whose youth was devoted to learning, whose early manhood was devoted to instruction, whose prime of life was devoted to research, and whose old age was devoted to the organization and development of institutions for the increase and diffusion of knowledge.

It falls not to my task to characterize the student life of George Hammell Cook. That his opportunities for training were wisely used is abundantly demonstrated by the monument of success which he unconsciously reared for himself in the years of his public activity. It is not in my province to speak of his professorial life. The scholars and public men who were guided into a higher intellectual life constitute a living monument to his fidelity and genius as an instructor.

It was as a man engaged in research that I first knew Professor Cook, and learned to honor his untiring industry, his deep insight, and his intellectual integrity. The catalogue of his contributions to science is long—too long to be recounted here, for it constitutes the annals of a long life. Only a few examples can be used to illustrate the wealth of his accomplishments,—in chemistry, geology, and geography.

In 1854 Dr. Cook became an assistant on the Geological Survey of New Jersey. This was his induction into scientific work. For three years the field of his research was in the southern part of the State, in the marl-beds and amid the potter's clay. Up to that time little attention had been given to these sources of wealth, and fields of industrial operations.

While in this field of labor, he discovered that a thorough geological survey must be based upon geography, and he constructed a topographic map expressly for the representation of geologic structure. His stratigraphic determinations were based largely upon instrumental measurements and carefully drawn plans and profiles of the land surveys. Thus was inaugurated in America a system of geological surveying which has gradually obtained ground until it is practically universal. The anatomy of the earth is exhibited in its topographic forms. Plains, valleys, terraces, hills, and mountains are full of meaning to the geologist, for in them is revealed the deep-seated structure of the earth and the history of that struggle between the great geologic powers which is forever in progress, and from the throes of which the continents are born.

The theatre of these early operations was near the coast, where the tides of the Atlantic ceaselessly surge to devour the land. Here his trained eye observed phenomena that led to a long system of observation and investigation, by which he ultimately demonstrated that the margin of the coastal plain of the Jersey shore is slowly subsiding, and that the sea is steadily enlarging its dominion. This work, as it has progressed through the years ending in his death, constitutes an important contribution to the facts and philosophy of the science of geology which he cultivated.

In 1864 Dr. Cook was appointed State geologist, and held the position until his death. His first task was found in preparing an elaborate exposition of the mineral resources of the State, which had been brought to light by earlier surveys; and he added to these a series of special investigations, such as were required for the symmetric treatment of the subject. This exposition was completed and published in 1868 in a large octavo volume accompanied by a portfolio of maps. He thus at the beginning cleared the field, systematized the existing knowledge, and developed a comprehensive plan for the researches which he carried on until the day of his death. To him geology was not wholly a speculative science. His conception of the duties imposed on him by being intrusted with public funds urged him to administer his trust in such a manner that the welfare of the State might be increased thereby. He did not neglect the great philosophic problems of his science, for he directed the investigations of the survey into structural geology, paleontology, chemistry, and geography; but he held over these researches a constant corrective by making them responsible for exact determinations of industrial

[1] Address of Major J. W. Powell at the funeral of Dr. G. H. Cook, late State Geologist of New Jersey.

value. A series of great economic problems was forever in his mind: How can these inundated lands be regained? How can the broad fields of New Jersey be fertilized? How can the potter's art be developed from the clays of the coastal plain? How can the deposits of zinc be utilized by the industries of the State, and how can the great beds of iron-ore be transformed into the instruments of modern civilization? And he applied the principles of science to these problems. Geography, geology, paleontology, and chemistry were all made subsidiary to the leading purpose of his survey.

Science was thus made to bless mankind, and the advancement of science did not lose thereby; science and industry in copartnership were each strengthened; industries of great magnitude and value to the people were steadily developed; and science itself steadily grew under the genius of his guidance.

The State of New Jersey is the seat of ancient seas. From the sediments therein deposited the rocks of the hills of New Jersey were made. The history of New Jersey through long geologic time is a history of innumerable earthquakes consequent upon the upheaval and depression of its lands. At one period in its history it was the scene of vast volcanic activity, when molten rocks poured to the surface. Built by the sea, it has been fashioned by the storm, and the waves of ocean have carved its shores with a fretwork of beautiful forms. Its low shores, its coastal plains, its broad valleys, and its billowy hills have been carved by rains and rivers until it presents a landscape of beauty. These physical features of the State, which express its beauty, and record its history, and reveal its structure, became one of the great studies of Dr. Cook when he began the topographic survey of the State. He lived to see that survey completed; and he gave to the industries of the land and to the science of the world the first great topographic map of a State constructed on this continent. Had this been his sole contribution to the knowledge of the world, it would have made him worthy of high honor.

With the increase of population in this country the ordinary wells which gather the water from the surface steadily become polluted, and dangerous to health and life. With the multiplication of manufacturing establishments, and through other agencies ever on the increase, the streams become polluted, and their waters are freighted with disease. The supply of pure water for domestic purposes to the people of the State of New Jersey early attracted the attention of Dr. Cook. With profound insight into the physical structure of the State, he early became convinced that the hills of the highlands constituted a catchment area for the waters of deep-seated rocks in the lowlands; and that, through these pervious formations outcropping above, the waters were filtered and purified, and could be reached by artesian boring along the coast. His prophecy was fulfilled, and now the beautiful towns of the region are made salubrious through the genius of his scientific induction. To-day thousands of wells extending along our coast from New York to Florida pour out the pure waters of life, and bless multitudes of people, and make their homes happy. The clouds of the highlands are tributary to the cottages of the coast, and the rocks deeply seated in the foundations of the earth carry them on their way.

Through long years of his life Dr. Cook was engaged in investigations relating to agricultural industries. The interests affected by these investigations are vast, for they are at the foundation of all prosperity. The facts and principles to be investigated are multifarious and complex, relating to climate, to soil, to vegetal life and animal life, and the relations of all these to human life. Science has done much for modern industries in manufacturing, in mining, in transporting, and in commerce; the hidden powers of the world have been discovered and tamed; but science has done comparatively little for agriculture; and Dr. Cook was one of the founders of a vast system of research, which has now been established throughout the land on a comprehensive and symmetric plan. Through the agency of these founders, of whom Dr. Cook was one of the leaders, experiment stations have been established in every State of the Union, endowed by National and State grants, and the greatest army of investigators ever organized under the sun is now at work on the complex problems of agricultural science. This was the crowning labor of a long and fruitful life. It has been a quiet but vigorous and efficient movement, and the people do not realize what has been done. The labors in this cause, of this beneficent friend of mankind, were untiring. They were conducted among men of affairs, in the seats of learning, in State legislatures, and in the National Congress. Everywhere his benign influence was exerted and felt, his counsels were taken with delight, and he became a leader of men where only the wisest and best men could be led. His appeal was to scholars and statesmen, and the counsels of the old man eloquent ultimately prevailed.

From the early history of civilization until the present time, many great thinkers of the world have been constructing temples of philosophy. It began with Socrates, Plato, and Aristotle, and this temple-building has continued through the times of St. Thomas Aquinas down to Hegel, Schelling, and Fichte, and even later to the days of Herbert Spencer. These theorizing philosophers have attempted to construct systems for the explanation of all things of the universe, and to build their philosophy upon a few "fundamental principles,"—postulates, presuppositions,—to construct temples founded on their domes. One by one these great philosophies have crumbled into dust, and we know them only by their ruins. The history of civilization is marked by the ruins of fallen philosophies, now most interesting to historical archæology.

In modern times another philosophy is being constructed,—the great temple of science. On this structure a vast army of scholars are at work through the multifarious methods of scientific research, and they are building this temple with its foundation on the granite base of fact. George Hammell Cook was a master workman on this temple, built as it is being built out of the facts and principles discovered by modern scientific research.

I knew Dr. Cook best as a counsellor and a friend. Having responsibilities thrown upon me kindred to those borne by him, I was glad to seek wisdom at his feet. Honest and pure, he was wise and far-seeing, and for his counsel I owe a debt of gratitude. His ways were characterized by directness and simplicity, and I learned to love him as a father, and be guided by him as a son. And now the wise old man is gone. This fountain of wisdom flows no more. The processes of time and change never cease. On we go with the stream of events. Shall our lives also make the world better?

The light is from on high.

The powers of the earth come from the heavens.

They who have wielded these powers best are placed in the firmament of history.

The method of human progress is not through "the survival of the fittest," for man is more than the brute.

The agency for the progress of mankind is the influence of the fittest. In all ages this has been recognized, now clearly, now dimly. In harmony with its principles, those who have best served humanity have been placed on high among the stars of history, that the light of their immortal deeds may forever shine upon the pathway of mortal men.

George Hammell Cook is among the stars. On earth he loved justice and he rendered justice; he loved the truth and he sought the truth; and, dead, he lives again, the star of justice and truth. O venerable friend! your counsels were wise, and your example was beneficent. Shine on to illumine our way to the truth and the right with the light of the knowledge of the glory of God.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The International Congress of Geologists.

I HAVE just seen a note of Professor Lesley's in your issue of June 13, in which he characterizes the statement of the May *Naturalist* regarding the action of the committee on organization

of the International Geological Congress as erroneous. In the June number of the *American Geologist*, p. 386, will be found an accurate print of the official type-written notes of that meeting by the secretary, Professor H. S. Williams, signed by him, and sent to me with the request for my vote on the question of appealing to the bureau to change the place of meeting. This official statement establishes, first, that of those present, Powell, Dutton, Gilbert, Hague, Marsh, Walcott, and Williams were officers of the United States Geological Survey, and Cope, Hall, Lesley, Stevenson, Whitfield, Winchell, and Frazer were not. The above comprised all who were present. Of those who were not members of the United States Geological Survey, Lesley, Stevenson, Whitfield, and Winchell voted for the submission of the question to the bureau.

Capt. Dutton of the United States Geological Survey did not vote. If the vote was as stated, 9 to 3, who constituted the nine? Professor Lesley rightly says Hall, Cope, and Frazer voted "no."

So much for the vote being carried by the members of the United States Geological Survey.

Major Powell moved that "it is the opinion of the committee that the place should be changed" (see the secretary's official notes). I was also present at the meeting, and can testify to the accuracy of the secretary's notes. Major Powell did *not* oppose the selection of Washington, but remained silent while it was voted.

Only after the meeting was it given out that Major Powell did not wish the congress to come to Washington. He certainly did *not* urge "that nothing be done by the committee to cause such an action abroad" (i.e., the change).

Both Major Powell and the writer of the above note emulated Shakspeare's Julius Cæsar in putting off the crown, but, like that hero, ended by accepting it. PERSIFOR FRAZER.

Sea Girt, N.J., June 30.

BOOK-REVIEWS.

A Handbook of Descriptive and Practical Astronomy. II. Instruments and Practical Astronomy. By GEORGE F. CHAMBERS. 4th ed. New York, Macmillan, 1890. 8°. $5.25.

PROBABLY at no time have there been so many amateur astronomers with good telescopes as at present, and for all these would-be astronomers this book on astronomical instruments and their use will have an interest.

Chambers's "Astronomy" calls for no introduction to public attention at our hands, as the fact that this is a fourth edition testifies; but it may be well to repeat, what we announced when noticing the first volume of this new edition some weeks since, that the revision this time will result in the production of several distinct volumes, each treating of some special phases of astronomical science. It is thus that the present volume is limited to instruments, their employment in observations, and the proper mounting and housing of them.

Every one who knows the possessor of a good telescope knows how desirous this possibly happy personage is to have his instrument where it can be used. To meet this very want, our author has introduced a number of plans for small observatories, suggested not only by his own experience, but also by that of several of his professional friends. We feel sure that these will be eagerly sought by the amateur astronomers of this country, as well as by those of Great Britain, for whom they are specially intended.

But it must not be supposed that America has been neglected, for good descriptions are given of some of our newest and best observatories.

One chapter is devoted to a history of the telescope, which gives a completeness to the work, and is likely to furnish answers to the queries of many a questioning visitor.

The use of the spectroscope in astronomical work, which has led to so many important results, and which has so much fascination for those who have not the time to follow up the older astronomy, is cared for in several chapters.

We commend this book, and trust its use may help a few on this side of the water to a more intelligent use of their time and their opportunities, so far as they have available instruments, in developing some really important investigation in astronomical physics. The play of seeing more clearly than with the naked eye the features of the "man in the moon" soon ceases to give pleasure, and bears no proportion to the real delight of securing some small addition to the world's stock of knowledge, which can be had as the result of some intelligent work. Let those who wish for this delight secure a copy of the book here noticed, that they may know more of what is within their reach.

The True Grasses. By EDUARD HACKEL. Tr. by F. Lamson-Scribner and E. A. Southworth. New York, Holt. 8°. $1.50.

THIS is a good translation of Professor Hackel's valuable contribution to *Die natürlichen Pflanzenfamilien*, that great German publication on the natural families of plants edited by Dr. Engler and Dr. Prantl. As Professor Hackel stands among the foremost agrostologists, his work, expressing as it does the latest and most authoritative views upon the subject, is especially valuable; and, as it contains so much that is of practical importance, we are glad to see it made available to English readers.

The work embraces the grass family as a whole, and enumerates the best-known economic species and their uses. It discusses the structure and morphology of the grasses and their arrangement into tribes and genera, and points out their characters in a manner that will enable one to classify readily any grass that may come into his hand. For the benefit of persons unfamiliar with botanical keys, an illustration of the manner of using the keys of analysis is given in a brief introductory chapter; and a full glossary and index are appended, adding much to the usefulness and value of the work, especially for private students and general readers. The illustrations, of which there are upwards of a hundred, are mainly reproductions from the originals in the German work, though a few were drawn especially for this translation.

The Elements of Machine Design. 11th ed. By W. CAWTHORNE UNWIN. New York and London, Longmans, Green, & Co. 16°. $2.

THIS admirable and unique treatise on the elements of the work of the mechanical engineer designing machinery has now been in use in schools and offices on both sides the Atlantic for some years, and has been repeatedly revised and continually extended, until, from a little volume of perhaps three hundred pages, it has grown to two volumes of larger extent; and a third part is more than half promised by its distinguished author. It is attempted by its writer to give a fairly complete account of the methods of proportioning parts of machinery, and especially of that representative machine the steam-engine, such as are in use in the best practice of the most successful builders, and such as are at the same time sanctioned by the best scientific authority. The work is in some respects, in English, a counterpart of that of Reuleaux in the German; but it is more directly adapted to the needs of the practitioner, and the custom and practice of the shops. It is a success, as is well indicated by the extent to which it has been adopted as a handbook and as a text-book, and by its rapid sale.

It gives a concise account of the materials used by the engineer; describes the various straining actions met with in machines; exhibits the results of research and experience as to straining action in structures and elements of machines; summarizes the results of latest experiments upon the strength of the several kinds of riveted joints, as used in boiler-work; determines the proportions of bolts, keys, and other connecting pieces, of journals and pins, and shafts and gearing. The principles of friction are applied in the determination of the proper proportions of bearings, and to the measurement of the efficiencies of machinery; while belting and rope transmission are given extended study. The second volume will deal with the details of parts of engines and machinery, and is promised for some time during the coming season. The third part will be devoted to the design of complete machines.

The book is brought up to date in a very satisfactory manner. The chapter on riveting is given large extent, and includes the results of the experiments of its author on riveting, as reported to the Institution of Mechanical Engineers. That on friction is the

only one in the modern technical literature of machine design, of this character, so far as we know, which includes the now well-known facts relating to the modification of the laws of solid friction by the introduction of the lubricant. The experiments of Hirn, who first discovered this modification, are alluded to, and those of Tower are given considerable attention; but, curiously enough, those of Thurston and of Woodbury in this country, which have been vastly more extensive, and which relate much more closely to the conditions of familiar ordinary practice, are not even mentioned, though they are now the basis of all rational work in the proportioning of journals, under other conditions than those of the Morin experiments, or of the comparatively rare "oil-bath" lubrication.

Elementary Dynamics of Particles and Solids. By W. M. HICKS. London and New York, Macmillan. 12°. $1.60.

THIS closely printed text-book, in the neat standard style of the Macmillans' publications of the class, is a well-written treatise on the elements of mechanics for schools and colleges. It is substantially of the same grade, and of similar extent, with those familiar to teachers as usually adopted in the English institutions of learning. In such a case there is little opportunity for originality, and the subject admits of but little safe or profitable variation from the almost universal and standard methods of treatment. As stated by its author, the chief points of novelty are the consideration of the division of statics as a special case of kinetics, and the methods of discussion of the ideas of mass and of momentum, which are considered before taking up the ideas of force and resistance. This the author thinks the best, if not the only logical, order of procedure; and especially so, as the whole must be subject to confirmation and proof experimentally. He would establish his work on this basis, rather than upon the usual system of assumption, from experience, of general laws, and a logical construction of the science by building upon those laws. The work is well done, and, for those who prefer this method of treatment, it will be found an excellent text-book. The order of treatment is, (1) rectilinear motion of a particle, (2) forces in one plane, (3) motion of rigid bodies. An unusually rich collection of problems and examples is given.

The second part includes the study of machines and the modification of their efficiency by friction; the book being intended, as the author says, to meet the wants of mechanical engineers, as well as the classes of schools and colleges. It will hardly meet the needs of that class, however, as it is far too elementary and incomplete, as a system of applied mechanics, for their purposes. The treatment of the machines is the ancient one of studying the "six" (?) elementary machines, considering the inclined plane and the screw as different in principle, and the lever and the wheel and axle as different elementary machines. They are well treated. In the chapter on friction we have an example of the curious persistence of ancient and obsolete notions among the writers of text-books, who seem rarely to keep themselves abreast of the progress of research. The old notions of Coulomb are here made the basis of the study of friction losses of energy; and the author of the book seems entirely unaware that they have been obsolete, as respects lubricated surfaces, since the days of Hirn's investigations a generation ago. The young engineers of to-day might give such writers useful hints. The table of co-efficients of friction (six constants) is from the now almost forgotten work of Morin. They are, of course, correct for the conditions under which they were obtained, but not for other and the various usual conditions of machine operation; and no clew is given to the limitations of their application. The distinctions between friction of solids, friction of fluids, and "mediate" friction, are not alluded to.

Gems and Precious Stones of North America. By GEORGE F. KUNZ. New York, The Scientific Publishing Company. 4°. $10.

THE author of this book is connected with the world-renowned firm of Tiffany & Co., and in his employment by this house as a gem expert has had a rare opportunity to become acquainted with the matters of which he treats in the book before us. Further, this expert knowledge has led to the employment of Mr. Kunz by the United States Geological Survey on special investigations, which have made him the more conversant with his subject.

It may be asked, Are any gems found in North America? This question evidently presented itself to our author, as he opens his somewhat large treatise with the statement that gems are found here in great variety, but that there has been little systematic exploration for them, as the indications are not such as to justify the employment of large capital in the search. In fact, a week's yield of the granite-quarries exceeds in value the yearly output of gems the country over; and a day's yield of the South African diamond-mines is of more value than the year's yield of all gems in North America.

It is not to be supposed, however, that there is no search going on in this country for gems, or that cases are unknown in which persons for a while believe themselves the possessors of stones of great value found in their corn-field or sheep-pasture. Reports of such finds are constantly coming in, and many of them reach the jewelry house of Tiffany & Co. The stories of these deceptive stones, as told by Mr. Kunz, are interesting, and show that a book of the kind he has now brought out, if available in the libraries of the country, might quickly explain to the possessor of a green stone the differences between colored quartz and emerald.

Nine chapters are devoted to the gems of North America, in which descriptions are given of the gems, and chemical analyses to show their composition. A chapter follows on pearls, in which due attention is paid to the method of their formation. There are then two chapters on the precious stones of Canada and of Mexico and Central America. The book closes with two chapters devoted to aboriginal lapidarial work in North America, and to the commercial value and uses of gems.

Aside from the gems found in this country, there is, as wealth accumulates here, a constant increase in the number of interesting gems held here by collectors, and of these Mr. Kunz has something to say.

The undoubted standing of Mr. Kunz as an authority on gems makes this work a real accession to the number of books to which one may turn for information; and, though the annual commercial output of gems is small in North America, we feel sure, especially as so many cognate subjects are treated within the book's covers, that there will be many—collectors and artisans—who will find it a help.

The execution of the book is to be praised in most respects,—the beauty of the colored plates, which are numerous and add much to its usefulness, is especially noticeable, and the general typographical appearance is excellent,—but there was evidently something wrong with the proof-reading, which left a long list of errors to be corrected in the unsatisfactory way of a list of errata.

AMONG THE PUBLISHERS.

THOSE who are interested in the uses, tests for purity, and preparation of chemical re-agents employed in chemical, microscopic, or petrographic analysis will find much valuable information in "Chemical Re-agents," by Charles O. Curtman, M.D., recently published by the John L. Boland Book and Stationery Company, St. Louis.

— Messrs. Longmans, Green, & Co. have issued a "Junior School Algebra." The author is William S. Beard, assistant master in Christ's Hospital. The book is intended for use in preparatory schools.

— "School Hygiene," by W. J. Abel, recently issued by Longmans, Green, & Co., contains simple directions respecting ventilation, eyesight, infectious diseases, and first aid in injuries. There is no attempt to explain the why and wherefore of the courses of procedure recommended. The manual is intended, as its title suggests, for use in schools, and it aims to describe what to do and how to do it, in case of diseases, accidents, etc.

— The leading articles in *Babyhood* for July are, "Fruit for Children," by J. W. Byers, M.D.; "Weaning," by D. Warman, M.D; "The Kindergarten on the Farm" (continued series), by Adele Oberndorf; and "The Baby's Mind," by Elizabeth S. Brown,

M.D. The medical editor announces that hereafter more space will be given to questions of diet, in the department of "Nursery Problems," this subject seeming to be of never-ending interest and importance to the magazine's readers.

— The United States Department of Agriculture has issued Parts I., II., and III. of a "Bibliography of the More Important Contributions to American Economic Entomology." As far as published, this bibliography consists of an octavo volume of 454 pages, devoted to the writings of Benjamin Dann Walsh and Charles Valentine Riley. The importance of these writings can be appreciated when one considers that this index to them must have cost the government several thousand dollars. Samuel Henshaw is the editor of the work.

— A copy of the seventh edition of Bloxam's "Chemistry, Inorganic and Organic," was recently received. Among the new matter introduced is an account of Raoult's method for the determination of molecular formulæ, and Fischer and Tafel's investigations on the synthesis of sugars. The chemistry of vegetation has also been rewritten to suit more modern views. The portions relating to explosives, to which the book to some extent owes its reputation, have been duly revised. The publishers in this country are P. Blakiston, Son, & Co., Philadelphia.

— In the "Proceedings of the Royal Geographical Society for March, 1889," was published a paper on "The Selkirk Mountains," by W. S. Green. This paper was accompanied by a map giving the results of Mr. Green's surveys in this little-known region. As the space available in the "Proceedings" was naturally limited, it seemed desirable that a more extended report of the trip should be published; and this we have in "Among the Selkirk Glaciers," a recent publication of Macmillan. The author first had his attention drawn to the Selkirks by the reports of two friends who attended the meeting of the British Association in Montreal in 1884, and later took part in the excursion west on the then uncompleted Canadian Pacific Railway. It was not till the summer of 1888, however, that Mr. Green, accompanied by a friend well tried as a travelling companion, made his expedition. One might suppose that a country reached by railway would offer little to explorers; but the difficulties presented by the Selkirks have debarred many travellers from venturing among them, so that we have in this book a valuable contribution to knowledge, as well as a well-written book of travel.

— "The Advancement of Science," by E. Ray Lankester, recently published by Macmillan, is a collection of essays printed in the various English reviews during the last ten or twelve years. The object of some of them was to help on government aid to science, and in general they were written with the purpose of informing the public of scientific progress. Naturally some statements of fact and theory are now a little out of date, but as a record of progress they have their value. The various titles are "Degeneration: a Chapter in Darwinism;" "Biology and the State;" "Pasteur and Hydrophobia;" "Examinations;" "The Scientific Results of the International Fisheries Exhibition, London, 1883;" "Centenarianism;" "Parthenogenesis;" "A Theory of Heredity;" and "The History and Scope of Zoölogy."

— Among the contributions in the forthcoming numbers of the English reviews for July, issued in this country in the original English form by the Leonard Scott Publication Company, New York, will be a paper recounting the particulars of a journey to Lhasa, the capital of Thibet, made by the Indian Buddhist scholar Sarat Chandra Das. This narrative, which deals with an almost unknown part of the world, has long been suppressed, in view of the information it gives to possible British rivals in Asia. Mr. Edward Bellamy will also have a paper in this number. The *Fortnightly Review* will contain, in addition to the usual variety of articles, one by Madame James Darmesteter, on "The Bookmen of Paris in the Fourteenth Century."

— The *Magazine of American History* opens its twenty-fourth volume with the July number. A portrait of Sir William Blackstone serves as frontispiece. Its pertinence is apparent to whosoever reads the leading article, "The Golden Age of Colonial New York." Mrs. Lamb has given a picture of the little metropolis of the province under kingly rule in 1768, conducting the curious

Publications received at Editor's Office, June 16–28.

Bazán, E. P. Russia: Its People and Its Literature. Tr. by Fanny Hale Gardiner. Chicago, A. C. McClurg & Co. 293 p. 16°. $1.25.

Bell, A. G. Memoir upon the Formation of a Deaf Variety of the Human Race. Washington, National Academy of Sciences. 86 p. 4°.

Campbell, D. H. Elements of Structural and Systematic Botany. Boston, Ginn & Co. 253 p. 12°. $1.25.

Deaf, Facts and Opinions relating to the. From America. London, Spottiswoode & Co. 1888. 195 p. 8°.

Dodel, A. Instruction in Drawing in Primary and Intermediate Schools in Europe and America. With an Introduction by Louis Prang. Boston, New York, and Chicago, Prang Educ. Co. 35 p. 16°.

Fontaine, W. M. The Potomac or Younger Mesozoic Flora. Parts I. and II. Washington, Government. 377 p, 180 pl. 4°.

Fraser, A. C. Locke. Philadelphia, Lippincott. 299 p. 16°. $1.25.

Minerals, Catalogue of, for sale by Geo. L. English & Co. New York and Philadelphia. 100 p. 8°.

Newberry, J. S. The Paleozoic Fishes of North America. Washington, Government. 340 p. 4°.

New York State Board of Charities, Annual Report of the, for the Year 1889. Albany, State. 411 p. 8°.

Noll, A. H. A Short History of Mexico. Chicago, A. C. McClurg & Co. 294 p. 16°. $1

U. S. Geological Survey, Eighth Annual Report of the, to the Secretary of the Interior, 1886-87. Parts I. and II. Washington, Government. 1063 p. 4°.

Wentworth, G. A. A School Algebra. Boston, Ginn & Co. 362 p. 12°. $1.25.

Wheelbarrow. Articles and Discussions on the Labor Question. Chicago, Open Court Publ. Co. 303 p. 12°. $1.

through its streets, houses, public buildings, and churches, to the commencement exercises of its college, to the founding of its Chamber of Commerce, to the king's legislative halls in Wall Street (with the governor, Sir Henry Moore, presiding), to the chamber of the City Corporation, and to the court-rooms, with descriptions of the men who figured in those places; while the newspapers, social affairs, amusements, shows, and quaint dress of the people are all depicted. Following this, Roy Singleton writes briefly of "Sir William Blackstone and his Work," the first volumes of which were already possessed by the principal lawyers of New York. "The Indian College at Cambridge," by Andrew McFarlane Davis, follows, with information on a subject little known; "Burgoyne's Defeat and Surrender, an Inquiry from an English Standpoint," by Percy Cross Standish, is interesting; "A Curious and Important Discovery in Indiana," by Ex-Lieut.-Gov. Robertson, gives a view of the links connecting the days of chivalry in France with those of adventure among the savage tribes of America; and then comes "President Lincoln's Humor," by David R. Locke. One of the most important papers in the number, however, is by the Boston divine, Rev. Samuel E. Herrick, D.D., entitled "Our Relation to the Past a Debt to the Future," which, although addressed to the people of Southampton, Long Island, may be taken home and appropriated by every community in the land.

— The number of the *American Journal of Psychology* just published (vol. iii. No. 2) contains the first chapter of the "History of Reflex Action," by Dr. C. F. Hodge, the introduction to which by Dr. G. Stanley Hall appeared in the last number. This important branch of both physiology and psychology is without an adequate historical treatment in English; and Eckhard's German treatise, published nine years ago, presents the subject almost exclusively from the standpoint of the physiologist. This chapter brings the record down from Descartes into the present century, summarizing the contributions of Willis, Astruc of Montpelier, Whytt, Haller, Unzer, Prochaska, and Legallois. The history will be continued in succeeding numbers of the journal. Mr. E. A. Kirkpatrick contributes a paper of "Observations on College Seniors and Electives in Psychological Subjects," based upon statistics collected for Dr. Hall a few years ago by the professors of philosophy in several Eastern and two Western colleges. Questions were asked on the following heads: reason for electing such subjects, advantage already gained from such studies, authors found most impressive, most interesting subject treated in the course. While not admitting exact statistical treatment, the answers "form a composite portrait of the positions held, and the educational value of these studies from the student standpoint, of significance for teachers of these subjects. They have not only educational but anthropological significance, and reflect many sides and phases of mental evolution or psychogenesis which an ordinary examination-paper does not touch." Dr. E. C. Sanford describes "A Simple and Inexpensive Chronoscope," depending on the principle of the vernier, adapted from Kaiser. With the home-made instrument described, measurements were made to a hundredth of a second. It is, however, in reviews of "Psychological Literature" and "Notes," to which more than a hundred pages of fine print are devoted, that this number excels. Besides the usual section on the "Nervous System" (by Dr. H. H. Donaldson), on "Experimental Psychology," and on "Psychiatry" (by Dr. William Noyes), Dr. Arthur MacDonald presents a second instalment of reviews on the psychology of criminals, and Professor Julius Nelson continues his biological-psychological study of the literature of heredity and sex. A number of pages are also given to reports from colleges East and West, where the "new pyschology" is taught, showing the work of the past year and the prospects for the future.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

AN EXPERIENCED TEACHER desires to hear of a town in which he can establish a high school. Or, he will lease an academy. Address, G., Lock Box 19, Suffern, N. Y.

WANTED.—By a lady-graduate of Cornell University, position as teacher in high school, seminary or college; prepared to teach the following branches, employing, so far as is practicable, the laboratory method: Geology, Botany, Zoölogy, Physiology; also, if desired, Physics, Chemistry, Logic and Psychology. References to heads of above-named departments in Cornell University. JENNIE T. MARTIN, care Cornell University, Ithaca, N. Y.

A GENTLEMAN of experience, highly recommended, liberally educated at home and abroad, desires to correspond with parties needing an instructor in the classics or modern languages in a high-grade institution. Address EARLHAM, Germantown, Pa.

WANTED.—At the Bryant Summer School, Roslyn, L. I., a Lady to teach Sea-Life, and other Sciences. July 8–Sep. 8. Ten weeks to six months according to her convenience. Other papers please copy. E. HINDS, A.M., Principal.

WANTED—Information concerning the production of Mushrooms in caves and other places. Address M. H. CRUMP, care Ky. Geological Survey, Frankfort, Ky.

A YOUNG MAN, graduate from an American College, who has studied a year in Germany, and is now studying in Paris, would like professorship in chemistry. References from some of the best chemists. Address CHARLES E. LINEBARGER, Poste-Restante, Paris, France.

WANTED.—An opportunity to study qualitative analysis in or near New York City during the summer. W. J. L., 130 Spring st., Sing Sing, N.Y.

ASSAYER.—Wanted position as above, has had three years' practical experience in a London firm of assayers to the Bank of England, Royal Mint, etc., etc. Thorough knowledge of bullion assaying, and of gold, silver and lead ores. I. FRED. JOHNSON, Northgate Brewery, Canterbury England.

CALENDAR OF SOCIETIES.

Royal Meteorological Society, London.

June 18.—W. Ellis, On the Difference produced in the Mean Temperature derived from Daily Maximum and Minimum Readings, as depending on the Time at which the Thermometers are read. In the publications issued by the Greenwich Observatory authorities, the maximum and minimum temperatures are those referring to the civil day from midnight to midnight. At many stations the observers only read their instruments once a day, viz., at 9 A.M, when the reading of the maximum thermometer is entered to the preceding civil day, and the reading of the minimum thermometer to the same civil day. Such stations are called "climatological stations." The author has tabulated the Greenwich maximum and minimum temperatures according to both methods for the years 1886–89, and finds that the climatological maximum and minimum means are in excess of the civil-day means. W. L. Dallas, On the Distribution of Barometric Pressure at the Average Level of the Hill Stations in India, and its Probable Effect on the Rainfall of the Cold Weather. The weather over India during January, 1890, was very dry, and in marked contrast to that which prevailed during January, 1889. The distribution of barometric pressure was, however, much the same in both months. The author has investigated the records at the hill stations, and has prepared charts showing the distribution of barometric pressure from both high and low level stations. From the high-level charts it appears that the mean barometric gradient in 1889 was rather more than twice that in 1890, and considering what is known of air movements, even at moderate elevations above the earth's surface, it may be assumed that these differences in pressure were accompanied with large differences of air motion; and, if it is also assumed that the evaporation over the Southern Ocean is in all years fairly comparable in amount, the deficiency of rainfall over India in the winter of 1889–90 can be attributed to diminished lateral translation of vapor, owing to sluggish movements in the upper atmosphere. W. Ellis, On the Relative Prevalence of Different Winds at the Royal Observatory, Greenwich, 1841–89. The author gives the following as the average number of days of prevalence of different winds for the forty-nine years 1841–89, as derived from the records of the self-registering Osler anemometer: north, 40 days; north-east, 45; east, 27; south-east, 22; south, 35; south-west, 106; west, 46; north-west, 22; calm, 22. A. B. MacDowall, On Some Recent Variations of Wind at Greenwich. J. P. Maclear, On the Action of Lightning during the Thunder-Storms of June 6 and 7, 1889, at Cranleigh. The author examined a number of trees which had been struck by lightning during these thunder-storms, and found that those which were struck before the rain fell were shattered, while those which were struck after the rain commenced were simply scored, with the bark blown off. It seems that during rain every tree is conducting electricity, and a disruptive discharge takes place where the conductor becomes insufficient. This depends on the position of the cloud, the amount of foliage on the tree, its condition of moisture, and its connection with running water.

Natural Science Association of Staten Island.

June 12.—Mrs. N. L. Britton, A Preliminary List of the Mosses of Staten Island; Arthur Hollick showed dried specimens of *Clematis ochroleuca*, collected during the past month at Richmond; L. P. Gratacap presented a block of Potsdam sandstone, beautifully ripple-marked from the drift at the base of the bluff on the shore at Tottenville, also clay iron-stone containing plant-remains and nodules of pyrite from the same locality, and lignite from the clay beds near Kreischerville; Ira K. Morris, Some Old Staten Island Springs.

Engineers' Club, St. Louis.

June 18.—Charles C. Brown, River-Pollution in the United States.

Exchanges.

[**Free of charge to all, if of satisfactory character.** Address N. D. C. Hodges, 47 Lafayette Place, New York.]

For exchange—14 volumes (1883–1889) American Journal of Science, 10 volumes (1880–1889) American Naturalist, 21 volumes (1879–1890) English Mechanic, all in good condition for binding; also, Morris Typewriter. Wants first-class microscope, camera, chemical or physical apparatus. Address, with full particulars, E. R. Chadbourn, Lewiston, Maine.

Wanted.—To exchange land and fresh-water mollusca, (principally *Helices Achatinellae*, Clausiliae and Limnaeae,) for those not in my collection. Lists exchanged. Address E. H. White, Box 200, Astoria, Or.

Meteorites.—Mr. George F. Kunz, 11 to 15 Uni n Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted—To furnish roots of *Dodecatheon Meadia*, *Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR. VOL. XVI. No. 388. | NEW YORK, JULY 11, 1890. | SINGLE COPIES, TEN CENTS. $3.50 PER YEAR, IN ADVANCE.

TORNADO LOSSES AND INSURANCE.

THE destruction of life and property by a tornado must ever be regarded as the most important fact from a practical standpoint, and in many respects this feature of the subject is involved in greater confusion and uncertainty than any other. As has already been said, such a violent storm ought to be exceedingly well defined, and the amount of loss determined within a small fraction. One reason for this uncertainty has been the lack of persons desirous of obtaining a complete list of property loss and damage by tornadoes. We have an excellent illustration of an opposite state of affairs in the estimates of loss of property by fire. Here there are hundreds interested in obtaining the exact loss; and it is believed that in this country the loss by fire, whether of insured or uninsured property, is known within four per cent of the actual loss. A most serious difficulty in making such estimates has arisen from a vague and indefinite idea of what a tornado is, and how it should be described. We are told, for example, "if we care for the name 'tornado' to define a distinct class of local storms, then the funnel-shaped cloud, as shown by a distinct rotary movement of the wind, or by peculiar destruction of property, should be made the condition of classification. Both for the purpose of study and practical results, this manner of distinguishing the tornado is desirable. It leaves no doubt as to where the line should be drawn, and recognizes a peculiar and important class of meteorological phenomena, independent of their effect upon life and property, which it is quite well known that they can destroy if given an opportunity." We must take most serious exception to these views. It is manifestly only by the effects displayed by these storms at the earth that we can classify or discuss them. The most violent commotions, the most surprising shapes and appearances of clouds meeting or rolling over each other, might have a passing interest, but surely they would be practically of no account if they did not reach the earth and there affect life and property.

Descriptions.

We have already seen that in the earlier history of these outbursts they became familiarly known by a definite name. For example: the New Brunswick (New Jersey), the New Haven (Connecticut), the Stow (Ohio), tornadoes are definite phenomena and extremely localized. In later times the most terrible tornado but one that has occurred in this country was that at Grinnell, Io. To call this the Poweshiek County tornado, and to say that it had a path 450 to 600 feet wide, takes from it almost entirely its definiteness and extreme destruction. In another instance a tornado is described as causing a loss of $4,000,000,—the greatest in this country, and, for that matter, in the world. This tornado is given a path 2,640 feet wide, and passing through Rock, Hennepin, Ramsay, and Washington Counties, Minn., and through St. Croix, Polk, Barron, Chippewa, and Price Counties, Wis. It is not intended, of course, to convey the idea that there was a clean sweep a half-mile wide through these nine counties; but, to one familiar with the more terrible storms, such a description would convey an idea of a most appalling disaster. A most careful study of this nine-counties tornado has revealed the most astounding result, that there were only two towns injured. The principal loss was at Clear Lake, Wis., $139,100; and the other town was Marine, Minn., with a loss of about $65,000. The total direct loss by this tornado in all the counties was not over $250,000, or one-sixteenth the published loss. It should be insisted on, by all means, that every tornado should have a definite local application and a name. In some cases where the country is thinly populated, and houses are destroyed here and there through many townships, it will be necessary to group all such hamlets in the name of a county or of the principal town visited, but this should be rarely resorted to.

Indirect Loss.

Much confusion has arisen from grouping together losses by the tornado proper, and by floods and hail which accompanied it; also by considering losses to orchards, crops, fences, stock, etc., in connection with that to houses and buildings. Certainly, in calculating risks for tornado insurance, and in studying the definite losses, we should catalogue only the definite and direct loss to structures. It is not a little remarkable, that, while the descriptions of tornadoes have tended to vagueness and indefiniteness as to extent of path and destructiveness, no such difficulty has been encountered in photographing the effects of a tornado. The most completely destroyed houses and blocks, and scenes exhibiting the severest violence of the storm, have always attracted the photographer. This country has had over two thousand tornadoes since 1873, but we would be very much deceived if we thought that the scenes of desolation depicted in half a hundred photographs were experienced at more than two per cent of these. The worst of these photographs are taken from only two or three tornadoes.

Tornado Lists.

These are being published from time to time, and in the main are very untrustworthy, from a lack of care in collation, and a desire to exhibit some preconceived idea as regards the tornado. A careful sifting of the lists has shown that many of these tornadoes were of very slight account,

and many also were straight blows with little violence. Often a whirling cloud does not reach the earth, but it is called a tornado. In one list the Wallingford (Connecticut) tornado of Aug. 9, 1878, is put down as only a heavy thunder-storm, although it ranks among the severest of all, for there were thirty killed, fifty houses destroyed, and $250,000 of damage done. There will be given later a list of forty-eight of the most severe tornadoes since 1873. No pains have been spared in making this list as complete as possible; and while in a few cases the loss may be slightly overestimated, yet in the main it is believed to be accurate.

Hinrichs's Views.

Mr. Hinrichs of Iowa has devoted many years to the study of tornadoes, and has given careful attention to the subject of a classification. A *résumé* of his views has been given in the *American Meteorological Journal* (vol. v. pp. 306, 341, and 385). He would make a careful distinction between a tornado and a squall, or *derecho*, as he would call it. The latter he describes as a straight-line heavy wind, usually advancing from the north-west for many miles across the State. While it is frequently destructive, yet it is of an entirely different type from the tornado. It is barely possible that there has been a slight confusion here, and that the apparent movement of the *derecho* from north-west to south-east is complicated by the occurrence of a series of tornadoes or destructive thunder-storms running in parallel lines from south-west to north-east. It hardly seems probable that we have to deal with a particular class of storm (*derecho*) in Iowa that is not found east of the Mississippi. What Mr. Hinrichs calls the "front" of the *derecho* may be either a thunder-storm or a tornado, and the universal law controlling these is a movement from south-west to north-east. We have already seen that these violent storms travel in parallel lines, beginning earlier in the afternoon at a point toward the north-west of a tornado region, and gradually working south-east. Each line occurs later and later, and it is also a fact that frequently the later storms have the longer paths. These appearances might also occur in a *derecho*.

Hinrichs's Classification.

The following shows the classification of tornadoes according to Hinrichs's method:—

A. Notable Tornadoes.
- Class I. Multiple.
  - (*a*) Large.
  - (*b*) Small.
- Class II. Single.
  - (*a*) Large.
  - (*b*) Small.

B. Minor and Doubtful Tornadoes.

Finley's Classification.

Lieut. Finley would make no effort at a definite classification according to violence or extent, but would take every funnel-shaped cloud, whether it reaches the earth or is seen in the clouds, and give it a county, date, time of occurrence, direction of motion, shape of cloud, and width of path.

Objections.

Neither of these methods seems satisfactory for our purpose. The first is quite involved, and, moreover, unites two tornadoes under the same head, though they may be twenty miles apart, provided they occurred on the same date. The motion of a tornado is complex: it oftentimes lifts, and passes a dozen miles before again striking the earth. Again, we have several occurring in parallel paths on the same date. To unite these together under the head of a "multiple tornado" seems very injudicious. It will serve to great definiteness if we consider each descent of a tornado-cloud, and each occurrence of destruction in parallel bands, as a separate tornado. My meaning should be distinctly understood. I would call the tornado of St. Cloud and Sauk Rapids, Minn., a single occurrence, because the cloud did not lift between these two; also the Louisville and Jeffersonville tornado was a single occurrence, for the same reason. I would call the Fayetteville (Arkansas) and Marshfield (Missouri) tornadoes separate occurrences, though having the same date, April 18, 1880. They were a great many miles apart, and, while undoubtedly in the same tornado region, yet they should be kept distinct.

Scale of Violence.

The establishment of a scale of violence is one of the most important steps to be taken at this stage of our studies and information. The question arises at once as to whether this scale should be according to the violence displayed in twisting trees and destroying houses, or according to the property loss. The former would be a very difficult matter to determine, but should certainly be coupled with the extent of region over which the manifestation occurred. It is also true that we should have with every tornado and destructive storm a definite estimate made, as impartially as possible, of the property loss. We may hope ere long that a beginning of interest will occur and develop in this direction, as has already appeared in the study of fire losses. By what precedes, it is plain that our ultimate arrangement of tornadoes according to a scale would place the more violent in a slightly different position from the more destructive; but this difference is exceedingly slight, and, until we make finer distinctions than are possible now, we can easily place the most violent and destructive in a class by themselves, or on a scale of 3 in class (3). Going to the other end of the scale, we will put the least violent at (1), and (2) will comprise all between these two. Of course, no hard and fast line can be drawn between these different grades, and some would put a few on the border of (2), in (3), and *vice versa*, but this is a very small matter. It is very important that in our lists the dates be arranged chronologically; but, if we wish to make a distinction between tornadoes at the border-lines, we may do so by using the plus and minus signs: for example, (3 —) would be near to (2 +), and (3 +) would be the highest in the scale. This would be a step toward dividing into nine classes instead of three. Another method of classification would be to determine the number of houses destroyed in each tornado, and then arrange the list on this basis. Such a list would not differ materially from the former. The only difficulty would be in assigning the proper number of houses under each scale. For purposes of comparison and in computing risks, we might also arrange a list of towns destroyed, or partly destroyed, according to an arbitrary scale. It matters little what method we adopt, for it is probable that any scheme

would give practically the same final comparison, but it is absolutely essential that we adopt some scale.

Authorities.

The most complete general description of tornadoes is to be found in the *Monthly Weather Review*, published by the Signal Service. In addition, we have descriptions of violent storms in our newspapers, and publications by Lieut. Finley. The most complete list of tornadoes has just been finished by Lieut. Finley in the *American Meteorological Journal.* This contains only the date, time of day, width and direction of path, and gives us no idea whatever of the destruction, which is by far the most important characteristic, and the only one that concerns us here. It has been found impossible to use this list, and the original authorities have been studied in making out a final description of tornadoes for this discussion. The method adopted for this list was to form as clear an idea as possible of the amount of violence and loss that should be given to each division of the scale, and then to put each tornado and violent storm rigidly in its proper place. If any doubt occurred as to whether the storm came, for example, in (3) or (2), it was indicated by a minus or plus sign, as just described. It was found necessary to begin the list with 1873, and it ends with 1888. The total number of tornadoes during these sixteen years was 2,221; or, by scale, 48 (3), 988 (2), and 1,185 (1). In the accompanying table are grouped these tornadoes in the seventeen States in which they are the most frequent. A careful study of this table will reveal most interesting and unexpected results. That Ohio, New York, and Pennsylvania should stand so high in this list is largely due to the fact that tornadoes have been so thoroughly reported in those States. A severe storm in any one of these States is noticed far more than in States where local storms are more abundant. An attempt has been made to determine the total tornado loss in these States. Outside of the forty-eight most destructive, scale (3), it is impossible to get an accurate estimate of the average loss. In two instances where the newspapers had reported great loss by a funnel-cloud, a careful examination revealed the fact that such a funnel-cloud had reached the earth; but the total damage in one case was $200, and in the other $75. Whatever may be the estimated loss, we have here the figures giving the number of tornadoes, and we can easily determine the true loss if at any time we find the average loss. After a careful study of the reports, it has been decided to place the average loss by tornadoes, scale (2), as $20,000 each, and by (1) as $3,000 each. There is no doubt at all that this estimate is at least ten per cent too great. The figures in the last column of this table give the total loss in each State. Taking the total number of tornadoes from 1873 to 1888, or 2,221, and dividing the total loss, $32,965,000, by it, we obtain $14,842 as the average loss by each tornado.

Résumé of Tornadoes, 1873–88.

	Number.					Loss.			
	(3)	(2)	(1)	Total.	Total by Weight.	(3)	(2)	(1)	Total.
Alabama......	3	55	20	78	139	$380,000	$1,100,000	$60,000	$1.540,000
Arkansas......	4	35	24	63	106	430,000	700,000	72,000	1,202,000
Georgia........		77	53	130	207		1,540,000	159,000	1,699,000
Illinois.	6	102	129	237	351	1,250,000	2,040,000	387,000	3,677,000
Indiana........	2	56	58	116	176	275,000	1,120,000	174,000	1,569,000
Iowa...........	3	61	75	139	206	740,000	1,220,000	225,000	2,185,000
Kansas........	3	103	109	215	324	350 000	2,060,000	327,000	2,737,000
Michigan......		31	48	79	110		620,000	144,000	764,000
Minnesota.....	3	29	45	77	112	1 000,000	580,000	135,000	1,715,000
Mississippi ...	4	25	18	47	80	620,000	500,000	54,000	1,174,000
Missouri.......	7	76	60	143	233	1,185,000	1,520,000	180,000	2,885 000
New York.. ...	1	49	70	120	171	80,000	980,000	210,000	1,270,000
North Carolina		32	30	62	94		640,000	90,000	730,000
Ohio..........	4	84	87	175	267	1,030,000	1,680,000	261,000	2,971,000
Pennsylvania..		45	66	111	156		900,000	198,000	1,098,000
South Carolina	1	29	20	50	81	200,000	580 000	60,000	840,000
Wisconsin.....	3	53	48	104	163	650,000	1,060,000	144,000	1,854,000
Total	44	942	960	1,946	2 976	8,190,000	18,840,000	2,880,000	29,910,000
All States ...	48	988	1,185	2,221	3,305	9,650,000	19,760 000	3,555,000	32,965,000

These figures are very significant, and will bear the closest scrutiny. We may make an interesting comparison with the only other list that is at all complete. This contains 2,435 tornadoes as having occurred in this country, with a total loss of $941,282,500, or a loss by each tornado of $386,564. Taking the forty-eight tornadoes in the above list, scale (3), we find the total loss, as carefully determined, $9,650,000, or a loss of $201,042 for each; that is to say, if the former estimate has any value at all, this country has been visited by 2,435 tornadoes, each of which was nearly twice as destructive as each one of the forty-eight tornadoes known to be most destructive. It is safe to say, that, were our Western States subject to such appalling disaster as this, they would have been depopulated long ago. We have just seen that from 1873 to 1888 the average loss by the 2,221 tornadoes was $14,842, with a margin of at least ten per cent too great an estimate; or, in other words, the actual loss from tornadoes in this country is one twenty-sixth, or only four per cent, of that estimated in the list above.

It will be distinctly understood that there is no desire in all this to make out that there is no danger from tornadoes, or to minimize their effects. It is of the utmost importance that the true facts be established; that the people understand that entirely unnecessary fears have been aroused; and that the extremest exaggeration has occurred from, it is to be feared, an unfortunate desire to influence their actions in regard to tornadoes. The worst is bad enough without exaggeration. Fears have also been engendered from an extreme agitation of this subject in the line of protecting lives from these outbursts. The protection of life is the most important of all, but there is no necessity of going to the expense of having a so-called tornado-cave constructed, and, above all, of spending hours in such a cave, as we have frequent reports of persons doing because of terror inspired by improper reports It is probable that no tornado ever visited a place without giving ample warning by the great roar (in some cases reported as thirty minutes, and even more, before the outburst) or by the unmistakable funnel-cloud. A cellar under the

house is an ample protection, and none other is really needed. Above all, the people of the West should allay their fears at the appearance of every threatening or lurid cloud in the south-west horizon.

Warnings.

As the Western States become more thickly populated, it is probable that some means will be resorted to, to warn the villages of the approach of a veritable tornado. Outposts placed at a mile or two to the south-west or west would have an excellent opportunity to watch for such outbursts, and give the signal for the inhabitants to watch for the cloud. It would be a great advantage to all concerned if people could realize that the tornado proper is an exceedingly definite and unmistakable phenomenon; that it does not come upon a house like a stroke of lightning, unseen and unheralded. Instances are by no means rare where the funnel has been seen advancing directly over a person, and has been easily avoided by running to the north or north-west. On the south side of the path there are indraughts extending to quite a distance; so that it is generally safer, unless the track of the tornado is seen to be quite to the north of the observer, for one to run to the north-west, but never to the north-east or east, as that is in the line of the tornado. Persons have stood within one hundred and fifty feet of the tornado on the north side, and have felt no unusual disturbance. It is admitted, however, that this requires no unusual courage. Let the people of the West look upon this phenomenon more in the light of its great peculiarity and wonderful nature,—a nature which has absolutely no parallel, and one the study of which must be for years to come of the highest importance. The wisest philosopher has hardly begun to get an inkling of its formation; and those who are so minded can, by a careful observation and record, help in obtaining and formulating the facts regarding this extraordinary appearance.

Can the Tornado Energy be Dissipated?

The time is coming when this question will become exceedingly important. It is very unsafe to theorize without some facts to start from. It is probable that often serious damage will be warded off from a town which has an extensive forest to the south-west and west. If the energy of a tornado is in an electrical action, as it most undoubtedly is, there is no reason why this may not be diminished by a properly arranged network of wires and poles to the south-west. A tornado is exactly the same as a water-spout at sea; and, if ships have broken up such a spout from the concussion produced by the firing of a cannon, there seems no reason why the energy of a tornado may not be largely diminished by the explosion of gunpowder or dynamite. Of course, the great difficulty would be to make the explosion anywhere near the tornado. Further than this, we cannot go without experiments, and, above all, without a better knowledge of the force producing the energy manifested.

Insurance.

Next to the loss of life and destruction of property by a tornado comes the practical question, "Can I and shall I insure my property against this loss?" Undoubtedly both the public and insurance companies have been misled on this subject, and yet it will be distinctly understood that in whatever is written here there is no censure implied. I have been in correspondence with these companies, and find that they have been groping in the dark; but they are watching tornado risks very carefully, and are prepared to make a change when such is deemed advisable. It is a remarkable fact, that, out of the thousands who have insured their property against tornadoes during the past six years, only two, so far as published, have received any return, and these for $2,000 each. If we should examine the returns for fire insurance, no such state of affairs as this would be found, and the reason for it is not far to seek. Usually tornado insurance is placed in the towns where a tornado has just occurred, and, like lightning, the path of a tornado never runs twice in the same line. When we consider the extremely narrow path of a tornado, this is not to be wondered at. After the recent tornado in Louisville, Ky., we are told that tornado insurance had a most extraordinary boom, and it was being placed at a rate even greater than that for fire insurance in some cases. This is most extraordinary, and can only be explained on the supposition that all classes had had their attention called to incorrect views, and were not cognizant of, or had not studied, the true relations of the subject. We have already seen that in the nine-counties tornado the actual losses of $250,000 were exaggerated to $4,000,000; but what shall be said when we learn that after the returns from all tornadoes were in, and we must consider that these returns represented far more than the actual loss, it was decided to multiply them by 25, that is, increase the losses by 2,500 per cent, on the plea that all the losses were not reported. It is not to be wondered at that under such manipulations every one has been very much mystified. As to the Louisville tornado, we shall find that Kentucky is not classed as a tornado State even. It is doubtful if another such tornado ever strikes Kentucky, certainly not in a hundred years.

Risk.

This whole matter of insurance depends on the risk. If a company should be organized to insure a house against being knocked down by a meteor, no one would dream of such a thing as noticing it, except in pity. No company was ever organized to place insurance against lightning distinctively; but the risk is so slight, that all or nearly all companies simply add that risk to the regular fire risk. I think it can be shown that the tornado risk is not so vastly different from that of lightning. Suppose a man's life is insured, and he wants to go into a tornado region: not one word is said by the company. But suppose the man goes South during the summer season: he must take his own risk, for the company will not take it. The difference in these cases is very plain: the chance of death in the first instance is perhaps one in a million or less, while in the second it may be one in a thousand or more. These illustrations will suffice to make this subject clear to those who have given no thought to it. If we can find the relative risk between lightning and tornadoes or between fire and the same, or if we can find the chance that any given house will be struck, we shall have a basis upon which to reckon the importance of this insurance. It is an eminently practical question to be solved by the law of chances, and not an undetermined factor, or a subject to be accounted for on the plea that it is the

working of an inscrutable providence; and we must be resigned to our fate if we do not insure against it. The fire hazard has been very accurately computed, and it is known approximately just how many persons will insure their property, and how high it is necessary to put the premium in order to pay the losses and expenses. Whenever a tremendous conflagration like that of Chicago or Boston breaks forth, these estimates are entirely wrong, and many companies are forced to the wall. It is impossible, however, to allow for such calamities; and it is probable, that, excepting some minor changes, no radical change in fire insurance has occurred on account of those fires.

Tornado Risk.

If we knew, approximately even, just the loss from tornadoes, and could place the insurance where the loss of houses blown down and the expense of insurance would not be greater than the gain in premiums, we would have an ideal state of insurance, and we could tell just the amount each householder should pay. Or if we knew just the average loss per year in the tornado States, and could persuade enough people to take up this kind of insurance, it is plain the business could be carried on profitably. One difficulty now encountered is, that people do not ordinarily see that the risk is any thing like that represented (which is true), and consequently only a small fraction of this kind of insurance is taken as compared with fire insurance. It would take a great many years to determine tornado risks with sufficient accuracy to estimate the amount of premium needed; but we can make a comparison with the risks and losses by fire, and thus arrive at an approximate solution of the question It should be noted, however, that these risks are of very different characters. The fire risk is ever present and a perpetual menace. Moreover, it is one which is in great danger of propagating itself, or becoming enormously great by communication from house to house. A tornado is more like an accident: it happens at the rarest intervals, and there is no spreading. We might compare these risks as those coming to a man's life in going to a fever district and in going to a tornado district respectively, as was done above It may be objected that we cannot compare fire insurance with that for tornadoes, in that fire losses are much greater in large cities, where the population is denser than in the country. The objection is not a serious one, for the reason that the greatest destruction from tornadoes has been in our large cities; and, again, the protection against fire is much more perfect in the city than in the country; in fact, insurance premiums are less in the city than in the country on a great many kinds of property.

[Continued on p. 22.]

NOTES AND NEWS.

THE *Open Court* of Chicago has republished in a volume entitled "Wheelbarrow" a series of articles and discussions on the labor question that have been appearing in its columns for some time past. The anonymous author of the work tells us in his introductory chapter that he was for a considerable part of his life a manual laborer, though he has since risen to higher positions. Hence he speaks of the workingman's life from actual experience, and so far is qualified for the work he has here undertaken. But unfortunately he has not taken the trouble to study the scientific aspect of the subjects he deals with, and even confesses his mental incapacity to do so. He has, however, many sound and sensible ideas, though none of them are new. He is opposed to all forms of communism and anarchism, and equally so to Henry Georgeism, and animadverts severely on the monopolistic spirit of the trades unions. But he writes in a coarse style, and often in a tone of arrogance and of bitterness towards capitalists that repels the reader. On the whole, we cannot see that he has contributed any thing to the solution of the labor problem.

—It is a well-known fact in biology that bacteria and bacilli absorb aniline and are killed by it. Two German observers—Stilling and Wortmann—have recently considered the possibility of utilizing this property in medical treatment (Humboldt). The diffusibility and harmlessness of violet aniline dyes (called, for brevity, "methyl-violet") without arsenic, in small doses, were first demonstrated on rabbits and guinea-pigs, as we learn from *Nature* of June 26. Then certain eye-disorders were produced in those animals, and treated with aniline solution, the results being excellent. The authors proceeded to operate on the human subject. A skin ulcer on a scrofulous child, which had been treated for a month with the ordinary antiseptic agents without success, was gradually healed by daily dropping a little aniline solution on the sore, and similar good results were had with bad cases of eye-disease. It soon appeared that many surgical cases were open to successful treatment in this way, and that, in general, wounds and sores developing suppuration could be sterilized with aniline. It is also thought that cases of internal inflammation, as in pleuritis and peritonitis, may prove to be not beyond the reach of this order of treatment.

—The commission appointed to consider the question of coal-waste in the State of Pennsylvania,—J. A. Price. E. B Coxe, and P. W. Sheafer,—who may be addressed at Scranton, Penn., are desirous of making the investigation as comprehensive and as exhaustive as possible. It is of course absolutely necessary to obtain the results of all the best practical experience upon the subject, so as to, as far as possible, diminish in the future the waste, and to encourage the utilization of what are now waste products. This commission would be very glad to have a full expression of views upon any of the following divisions of the subject which they have adopted for the study of this most important problem. The divisions are as follows: geological and statistical waste, including estimate of the original geological coal-field and waste of erosion, estimate of existing coal-field before coal-mining began, estimate of amount worked to the present year, and estimate of the total amount that it is possible to take from the earth by any known system of mining (giving the amount that must be left in the ground in shape of pillars, etc., or what may be regarded as permanent structural waste); waste of producing and marketing, including investigation of the underground waste of mining, investigation of the waste of preparation (including all processes in which the commercial size has been continually reduced, the amount of culm in sight at place of preparation, and the annual product of culm), and investigation of the marketing of the pea, buckwheat, bird's-eye or rice, and dust, and the uses to which the several sizes or conditions are put; utilization of coal-waste, including examination of the whole briquette system, duly recorded tests under responsible supervision, patent office records, specimen forms, and chemical analyses, accumulation of the record of all the practical mechanical appliances by which the waste is utilized without mechanical preparation (such as devices of furnaces, grates, blowers, etc.), investigation of the use of waste after mechanical preparation for combustion (as in pulverized conditions, etc.), and examination of the gasifying processes into water-gas and producer-gas, also in the destruction of garbage or cremating work, also in agricultural experimentation.

—According to a newspaper bulletin just issued by Dr. C. M. Weed, entomologist of the Ohio Experiment Station, the maple bark-louse has become destructively numerous over a large portion of Ohio, and is creating much alarm by its presence. It is especially at work upon the shade-trees of cities and villages, and unless checked there is every indication that the trees will be seriously injured. The insect has been reported as very abundant

in Cleveland and Canton, and is present in many parts of Columbus. It probably occurs, also, in a large number of other cities and towns of the State. The presence of the pests is shown by the occurrence upon the twigs of maple-trees, especially on the under side, of a brown, circular, leathery scale about one-quarter of an inch in diameter, beneath which is a fluffy, cottony mass, that at this time is alive with hundreds of young lice, appearing to the unaided eye as minute white specks moving about. About six years ago there was a similar outbreak of this insect in Ohio, Illinois, Michigan, and adjacent States, when many trees were rendered unsightly and filthy by the presence of the lice, and some were killed by the attack. This maple bark-louse is an insect belonging to a family of peculiar habits and histories. Under each of the scales there was a month ago from 700 to 1,000 small white eggs. These eggs have since hatched into young lice, which are now scattering over the trees, and will soon fix themselves upon the leaves, where they will remain throughout the season. They insert a tiny beak into the leaf, and suck the sap. In autumn before the foliage drops they desert the leaves, and fasten themselves to the twigs. Much of the sap that is sucked from the foliage passes through the bodies, and falls to the ground. This is frequently called honey-dew. Some of the most intelligent citizens of Columbus report that during the outbreak of 1884 they cleared their shade-trees of the scales and young lice by using a stream of water from the hose, forcing it into the trees, and washing them off. When this simple water treatment is not practicable, the next method would be spraying with what is known as kerosene emulsion. These bark-lice have various natural enemies, which prey upon them. These enemies checked the outbreak quite suddenly in 1885, and probably in a year or two they will reduce their present numbers below the danger line; but in the mean while artificial remedies should be used as much as practicable.

—*Das Wetter* for May contains an article by Dr. P. Perlewitz upon the influence of the town of Berlin upon its climate. He finds, as given in *Nature*, that the difference of the mean temperature between the town and the open country outside differs, in various months, from 0.7° to 2.3°, the town being always warmer. The smallest differences are in spring and winter. The greatest daily differences are found to be in the evening, owing to a retardation of radiation in the town. From this time the difference decreases until about mid-day, when there is no perceptible difference between the two localities. Dr. Hann has found similar results for Vienna; but the differences there are smaller, owing to the better exposure of the town station. The humidity is less in the town than in the country. In the evening, in June and July, the difference amounts to above 19 per cent. No appreciable effect appears to be exerted by the town upon the rainfall, as compared with that of the country stations.

—Mr. Belelubsky, professor at the Institute of Roads and Waterways at St. Petersburg, was some time ago instructed by the minister of public works to make an examination of the suspension bridge over the Dnieper at Kiew, which was erected some forty years ago by the late Mr. Charles B. Vignoles, and to give an opinion as to the quality of the metal used in its construction. Luckily, from a scientific point of view, a number of extra links which had been provided at the time of the erection of the bridge, were still in store, and it was thus possible to determine by comparative tests what changes the material of the links of the bridge had undergone in their forty years of service. The links in question, according to *Engineering* of June 20, were about 11 feet 9 inches long, by 11¾ inches broad, by 1 inch thick. Stated briefly, the results of the tests show that the iron has not at all deteriorated during its long service. The mean of four specimens of links taken from the bridge gave an ultimate strength of 20.7 tons per square inch, with an elongation of 14.5 per cent on 8 inches, while an equal number of tests of specimens from unused links gave a breaking stress of 22.2 tons per square inch, with an elongation of 13.4 per cent in 8 inches.

—There is a disease in Japan known as *kakké*, a disorder of the kidneys communicated by bacilli, and closely related to the more virulent *beri-beri*. From the distribution of *kakké*, M. Gueit, as related in *Nature*, has drawn conclusions as to the ethnic composition of the present population of Japan. The fact that Chinese always escape the disease, even in localities where it is very prevalent, indicates (in his opinion) that the Chinese or Mongolian element is not the dominant one. He finds three constituents in the population: (1) descendants of Ainos; (2) descendants of Negritos; and (3) a Malayan element, which is the most prominent. Wherever the Malayan goes, he brings with him the *beri-beri* order of disease, his liability to this being probably due to the Hindoo blood in him. From India we find *beri-beri* spread, like the Malays, to Madagascar on the one side, and to Japan on the other; we meet with it also in Java, Sumatra, etc. According to the proportion of Malay blood in the natives of Japan is the frequency of the malady, which occurs in various forms and under different names. As to the Negrito element in Japan, M. Gueit found an interesting proof of it in the island of Sikok, in the form of a small statuette of Buddha, having the characteristic nose and hair of the Negritos.

—The long imprisonment of beetles within furniture is treated of in the last report issued by the New York State Museum of Natural History. It is suggested that when such cases occur, the conditions may bring about a lethargic state in which respiration and accompanying phenomena are almost or entirely suspended through the complete exclusion of air by the rubbing, oiling, and varnishing or other polishing the furniture has undergone. This instance of the imprisonment of a beetle is cited, says *The Illustrated American*: "In 1786 a son of Gen. Israel Putnam, residing at Williamstown, Mass., had a table made from one of his apple-trees. Many years afterwards the gnawing of an insect was heard in the leaves of this table, which noise continued for a year or two, when a large, long-horned beetle made its exit therefrom. Subsequently the same noise was heard again, and a second insect, and afterward a third, all of the same kind, issued from this table-leaf; the first one coming out twenty, and the last one twenty-eight, years after the tree was cut down."

—Dr. G. Hellmann, to whom meteorologists are indebted for various interesting investigations into the history of meteorology, has contributed to *Himmel und Erde* (Heft. 3 and 4, 1890) two instructive articles on "The Beginnings of Meteorological Observations and Instruments." He divides the history of the development of observations into three periods: (1) that ending with the middle of the fifteenth century, up to which time they were of a very fragmentary and almost aimless character; (2) that in which observations were taken at least once a day; and (3) that in which they were systematically taken with instruments, dating from about the middle of the seventeenth century. It is not exactly known who first kept a regular meteorological journal; but Humboldt attributes it to Columbus, on his first voyage to America in 1492, while the Italians also appear to have made daily observations from the middle of the fifteenth century. The wind-vane is by far the oldest of the meteorological instruments. In the periods of Homer and Hesiod, in the ninth and eighth centuries B.C., the qualities of the winds were correctly described. The first arrangement for observing the wind-direction is the Temple of Winds at Athens, which was built about 100 years B.C. A picture of this tower is given by Dr. Hellmann. Eginhard, in the reign of Charlemagne, denoted the winds by the four cardinal points, and their variations. The first instrument for denoting the force of the wind is ascribed to Robert Hooke (1667). This instrument is essentially the same as that now used, and known as Wild's pendulum anemometer. The absorption or organic hygrometer was invented about the middle of the fifteenth century, by N. de Cusa, although the invention is generally ascribed to L. da Vinci. The first condensation hygrometer is attributed to the Grand Duke Ferdinand II. of Tuscany. The first continuous hygrometrical observations appear to have been by R. Boyle, at Oxford, in June, 1666. The first thermometer is attributed to G. Galilei, towards the end of the sixteenth century. Some few years later, the instrument was improved, although the freezing-point was the only fixed point determined; and the graduation was made by means of little knobs in the glass, every tenth one being enamelled. The first rain-gauge was used by B.

Castelli in 1639, although usually a later date is quoted. The discovery of the Torricellian tube, in 1643, is too well known to require special remark. These are only a few of the very interesting points referred to in Dr. Hellmann's instructive investigations.

—At the regular monthly meeting of the American Institute of Electrical Engineers, held June 17, 1890, the following resolutions, recommended by the council, were introduced by Mr. Francis B. Crocker, with the request that they be taken up for action at the next meeting of the institute in September: "Whereas it has been the custom in the nomenclature of electrical units to perpetuate the names of men who have contributed most to electrical science; and whereas, in the names thus far adopted, the eminent services of Americans have not been recognized: therefore resolved, that, in the opinion of the American Institute of Electrical Engineers, a just distribution of the honors thus bestowed necessitates a recognition of the splendid contributions to electrical science of one or both of America's great electricians,—Benjamin Franklin and Joseph Henry; that this institute will gladly co-operate with other bodies in this country and abroad to secure the general adoption of these names for electrical units; that the name of 'Henry' should be given to the practical unit of self-induction, since he was the discoverer and greatest investigator of this phenomenon, and because this unit at the present time is called a quadrant, which is merely a numerical value, and not a suitable name; and that this institute recommend to electrical societies and electrical engineers the general use of the name 'Henry' for the unit of induction as being the quickest and surest way to secure its final adoption." It is unfortunate that the name of "Henry" for the unit of induction was not adopted at the Paris Electric Congress of 1889. If the attention of the congress had been forcibly called to the fact that Henry discovered self-induction, and that his work on both self and mutual induction was of the greatest importance, his name would probably have been adopted then. Henry's discovery of self-induction, which is, of course, the fact that gives the strongest claim, was made in 1832, and published the same year in *Silliman's Journal*. In that paper he described experiments showing that the spark obtained by breaking a circuit composed of battery and a long wire is greater than with a short wire, and that the spark is further increased by coiling the wire. He then clearly states that the phenomenon is due to the action of the current on itself, all of which is perfectly correct, and would be a good statement of the facts even at the present time.

—The thirty-ninth meeting of the American Association for the Advancement of Science will be held at Indianapolis, Ind., beginning on Tuesday, Aug. 19, 1890, at noon, by a meeting of the council at the Denison House, where will be the hotel headquarters of the association. By special favor of the State authorities the general sessions and the meetings of the sections will all be held in the new and commodious State House, where also will be the offices of the local committee and of the permanent secretary. This meeting will be the fiftieth anniversary of the organization of the Association of Geologists and Naturalists, the parent of the American Association, which will add to the interest of the meeting. The arrangements made by the local committee for the comfortable entertainment of the large number of members and their friends expected to be present, and the unusual accommodations offered, by which all the sections will meet in large halls under one roof, will probably make this the most important meeting ever held in the West. Indianapolis is as comfortable in August as any city away from the seacoast. Its streets are wide and well shaded, and its hotels are large and comfortable: so members need not be deterred from going there by the fear of extra heat and discomfort. On Wednesday, Aug. 20, the first general session of the meeting will begin at ten o'clock in the forenoon in the House of Representatives. After the adjournment of the general session, the several sections will organize in their respective rooms. In the afternoon the vice-presidents will give their addresses before their respective sections; and in the evening there will be a general session, when the retiring president, Professor T. C. Mendenhall, will deliver his address. The sessions will continue until the Tuesday evening following; and on Wednesday morning, Aug. 27, a meeting of the council will be held. Saturday, Aug. 23, will be given to excursions. The meeting will close with excursions extending to Aug. 30. A special circular in relation to railroads, hotels, excursions, and other matters, will be issued by the local committee; and members who are about changing their address for the summer should notify the local secretary at once, and he should be addressed upon all matters relating to local arrangements and in relation to transportation. For all matters pertaining to membership, papers, and business of the association, address the permanent secretary at Salem, Mass., up to Aug. 15. From Aug. 15 until Aug. 30, his address will be The Denison House, Indianapolis, Ind.

—The death-rate in England in 1889, according to *Medical News* of July 5, was 17.9 per 1,000; in 1888, 17.8 per 1,000. For each of the nine years 1881–89 the rate was lower than in any year prior to 1881, and the average annual rate for that period was only 18.9 per 1,000. For the ten years 1871–80, the average annual rate was 21.4 per 1,000. This shows a saving of 2.5 in every 1,000 of the population, comparing the last two decades with each other. The registrar-general of England estimates that not less than 600,000 people in England and Wales at present survive by reason of the declining mortality rate; that is, if the rate 21.4 per 1,000 had persisted in the past nine years instead of falling to 18.9, there would have been 600,000 more deaths. This improvement is no doubt largely referrible to the improved sanitary condition of the United Kingdom, more especially in the great cities. One proof of this is seen in the decreasing mortality from zymotic diseases, such as small pox, scarlet-fever, and typhoid-fever. Infant mortality, also, has shown a marked decline, and is another index of the life-saving results of an improved sanitation.

—Miss Fawcett's triumph in the mathematical tripos puts the crown on a long series of successes by lady students at Cambridge. There have now been lady "seniors" in all the important triposes (except law). Here is the list:—Moral science tripos: in 1880 Miss Jones was bracketed senior, in 1881 Miss Moberly was senior, and so in 1884 was Miss Hughes. Historical tripos: in 1886 Miss Rolleston (daughter of the late Oxford professor of zoölogy) was bracketed senior, and in 1887 Miss Blanche Paul was similarly placed. Mediæval and modern languages tripos: here there have been four lady seniors. In 1886 two ladies and no men were placed in the first class. The ladies, who were placed in alphabetical order, were Miss Chamberlain and Miss Skeat (daughter of Professor Skeat). In 1887 Miss Harvey was senior; and in 1888, Miss Tuke (whose father is well known in connection with schemes of Irish emigration). Finally, there are the successes of Miss Ramsay in the classical tripos (1887), and of Miss Fawcett in the mathematical (1890). Of these eleven lady seniors, two came from Girton (Miss Jones and Miss Ramsay), the rest from Newnham. It is often asked what becomes of lady students when they leave college. A few particulars about some of these lady seniors may therefore be added. Miss Ramsay is now Mrs. Montague Butler, the wife of the master of Trinity; Miss Moberly is head mistress of the Tunbridge Wells High School for Girls; Miss Hughes is head of a training-college at Cambridge; Miss Chamberlain is instructor in German at Bryn Mawr College, Philadelphia; and Miss Jones is moral-science lecturer at Girton. Promptly to repair the apparent neglect of legal studies came the news of the success of women law-students at Paris, where Mlle. Belcesco, a Roumanian girl, has just taken her degree as *docteur en droit* after obtaining the highest place in the licentiates' examination. A French lady and two of Russian birth also did well. The London *Daily News* tells us one or two interesting facts about Mlle. Belcesco,—that she means to practise at the bar at Bucharest, confining herself to the cases of poor women who cannot pay counsel; and that her thesis for admission to the Paris faculty contained seven hundred pages, of which two hundred were, with an exercise of prudence on the part of the lady, not read. The fact that not Portia herself would be allowed to practise in England no doubt explains why women have not yet carried off the honors of the law tripos at Cambridge.

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TORNADO LOSSES AND INSURANCE.

[Continued from p. 19.]

Constancy of Tornadoes.

It is an exceedingly important question to determine, if possible, whether tornadoes are on the increase, or whether we may reason from their occurrence in the past as to their probable action in the future. The tendency is to take serious alarm when a tornado has happened near a community, and to conclude at once that the risk has suddenly become very much greater than before, and is likely to continue. We may cite as an instance the alarm in a good many minds after the occurrence of the recent Louisville tornado. Notwithstanding the fact that this was the first serious tornado in Kentucky, and that in all probability another such would never occur there, certainly not in Louisville, yet many seem to have thought that a change had come in the climate, and we were now to have more of these outbursts. A careful study has shown that such fears are groundless, and that our climate is practically constant. We may strike an average of tornadoes in the past, and reason that there will be no more than that average in the future. In fact, if we include 1883 and 1884 in our average, we know that it will be too great, for a very large number of tornadoes occurred in those years. It is to be noted that the reports of tornadoes must necessarily increase as houses increase in the tornado States, but this will be balanced by the fact that fire losses will also increase. It is perfectly safe for us to compare fire and tornado losses, and to determine approximately what the comparative premium should be.

The accompanying table shows for the years 1876–84, in the seventeen tornado States, the total loss by tornadoes of scale (3), (2), (1); the loss by fire during the same years; and the relative loss by the two.

Tornado and Fire Losses in Seventeen States, 1876–84.

	Number.			Loss.		
	(3)	(2)	(1)	Tornado.	Fire.	Tornado / Fire.
Alabama........	1	30	8	$704,000	$6,169,000	1-9
Arkansas........	3	21	18	754,000	6,419,000	1-9
Georgia........		54	32	1,176,000	14,083,000	1-12
Illinois........	4	77	87	2,601,000	38,060,000	1-15
Indiana........	1	42	30	1,005,000	22,981,000	1-23
Iowa........	3	42	50	1,730,000	14,821,000	1-9
Kansas........	2	77	68	1,944,000	6,108,000	1-3
Michigan........		24	18	534,000	30,583,000	1-57
Minnesota........	2	20	23	1,069,000	18,752,000	1-18
Mississippi........	4	21	15	1,085,000	5,479,000	1-5
Missouri........	7	61	45	3,250,000	27,129,000	1-12
New York........	1	34	33	859,000	124,767,000	1-145
North Carolina........		18	11	393,000	6,486,000	1-17
Ohio........	2	42	35	1,225,000	41,496,000	1-34
Pennsylvania........		22	22	506,000	69,869,000	1-138
South Carolina........	1	24	12	716,000	7,747,000	1-11
Wisconsin........	3	39	33	1,529,000	21,375,000	1-14
Total........	34	648	540	20,080,000	462,324,000	1-23
Total, omitting Pennsylvania & New York	33	592	485	18,715,000	267,688,000	1-14

The tornado loss in this table has been rigidly computed from the actual estimated loss for scale (3), and allowing $20,000 each for (2), and $3,000 each for (1). There is no doubt that this loss is more than ten per cent too great. It should also be remembered that during the two years 1883 and 1884 there were as many tornadoes as in the remaining seven, and in the sixteen years thus far studied this is very nearly the relation. There are several most astonishing facts brought out in this table, and such as are very difficult to understand. Perhaps the most surprising result is that in Kansas the tornado loss is one-third of that by fire. I have gone over the data, and can find no flaw. All the tornado reports from the different States were treated exactly alike, and the result for any one State may be compared directly with that for any other. In Nebraska, a neighboring State, the tornado loss is insignificant, not more than one-twentieth of that by fire; and in Missouri it is one-twelfth of the fire loss. Of course, where no estimate of the loss is given, as is the case in more than half the occurrences, the position in the scale is dependent on the reported violence of the tornado. I am inclined to think that Kansas has had

its severe storms multiplied by reporters to too great an extent. It seems necessary to give these figures exactly as they came out; and I shall be very much gratified if the citizens or professional men of any State, feeling that their State has not been given a fair show, should make for themselves a careful canvass of the State for tornado losses. I shall be pleased to send to any such State a list of the dates of all the tornadoes reported from that State, for the authorities or those interested to verify the losses sustained. I have attempted, by correspondence and in other ways, to get more complete returns, but there seems to be great apathy on this question. Possibly many have been very much discouraged at the palpable exaggerations that have been published. It seems to me that this matter is of the greatest importance, and now is the time to establish an accurate estimate of tornado losses which will be of permanent value for comparison with future years. Certainly more harm will come from vague reports of doubtful tornadoes and exaggerated statements of losses than can ever come from an exact knowledge of the truth. There is no doubt that there is a tornado evil. Let us learn its exact proportions, and then people will know just what to prepare for.

I do not think that in this table the States of New York and Pennsylvania can be regarded as full-fledged tornado States. Moreover, the comparative loss between fire and tornadoes is not the same as in the other States, owing to the relatively greater loss by fire in the cities in these two States. I have therefore taken out these two States in the final summing-up of the table. Kansas has been left in, however. We find that in the fifteen remaining States the relative loss was one-fourteenth; that is to say, the loss by tornadoes is seven per cent of that by fire. I think we may safely say that any fire insurance company would be entirely secure if they increased their premium by eight per cent or ten per cent, and assured the householder against loss from tornadoes as well as fire, provided such insurance could be placed through all the fifteen States, and for a term of four or five years. As will be shown later, there seems to be good evidence for believing that once in eleven years the risk from tornadoes is somewhat increased for two or three years. When we see that insurance companies, computing from imperfect tornado losses multiplied by 25, have charged the same for both fire and tornado insurance, it is not to be wondered at that so few have taken the latter. Every one has the evidence of his senses that tornado losses in his community in fifteen to twenty years, excepting a few of the more disastrous tornadoes, have not equalled the average fire loss in a single year. It is said that such matters generally adjust themselves through a competition and rivalry between different companies, but it is very unfortunate for a few who have to suffer while this adjustment is taking place. Will it not be far more satisfactory to insured and insurers if this subject be thoroughly ventilated, and a good idea of the comparative risk between fire and tornadoes be arrived at? It should not be forgotten that it is only by uniform action and support of both fire and tornado insurance by the people in the fifteen States, that any thing like an average result can be obtained; or, at least, this must be the case in any one State, for there are a few lines of action in the State which seem to be more favorable for the development of tornadoes than the whole area of the State. H. A. HAZEN.

M. PASTEUR AND HYDROPHOBIA.[1]

IT is now five years since M. Pasteur introduced to the medical world his alleged cure for hydrophobia. If his much-vaunted discovery possesses all the merits which have been claimed for it, he has earned a fair title to the gratitude of mankind. If, on the other hand, it can be shown that all his theories depend for their acceptance upon a number of very serious fallacies, and that his alleged cures are no cures at all, inasmuch as in those cases the disease never existed, and yet further, that in many cases his treatment has actually induced hydrophobia where it was previously non-existent, M. Pasteur's claim to be regarded, on account of this treatment, as a benefactor of his race, must fall to the ground.

It is now thirteen years since I first wrote a series of articles for the *Medical Press and Circular* on this subject, and they were subsequently published in book form under the title "Rabies and Hydrophobia." On that occasion I pointed out a very serious fallacy underlying many cases of alleged cure of this disease,—the fallacy of regarding persons bitten by healthy dogs as in danger of hydrophobia. At that time I investigated carefully a number of cases of alleged cures by a clergyman residing near Burnley, who had a great reputation in Lancashire for the cure of hydrophobia. The result of my inquiry showed that the Rev. Dr. Verity, the clergyman in question, had had a large number (two thousand) of dog-bitten patients. A few of them had died from hydrophobia after his treatment; but the majority escaped, the reason being that they had been bitten by non-rabid dogs, or had been bitten through clothing, etc. I inquired into numerous other alleged cases of cure of hydrophobia, but always with the same result; and I was thus led to formulate this proposition,—'that if any one obtained a reputation for the prevention of hydrophobia, and if all the dog-bitten sought or took this remedy, the result would be statistically favorable."

When M. Pasteur startled the world by his first statistics, I was disposed to believe that in the hands of a man of such great scientific fame a cure had been found. I could not, however, avoid noticing the same fallacy running through his statistics which characterized the returns made by the Rev. Dr. Verity. The dog-bitten were certainly rushing to M. Pasteur; but the results were robbed of much of their marvellous character if it could be shown, that, owing to panic and fashion, great numbers bitten by non-rabid dogs were seeking protection.

This objection was supported by another, very powerful consideration. I found, on carefully comparing the statistics given by M. Pasteur with those of the years which preceded the introduction of his system, that the supposed rabid dog-bitten in France had increased in extraordinary proportions: while, at the same time, the average mortality from rabies in France had shown but little fluctuation.

The arguments I have already given are such as will appeal at once to the lay mind. There are, however, certain scientific objections which are still more cogent. The action of the supposed prophylactic, when examined, resolved itself into pure empiricism. A number of injections of rabbits' spinal cords, that had been dried from fourteen to five days, were used, and the old *post hoc* argument was employed: because the children treated by these injections did not subsequently develop hydrophobia, therefore the prophylactic was the remedy. This simple proposition loses its force, however, when we note carefully what really happened. In one series, cords were used based on one formula. Some "cures" resulted, but deaths also occurred. Then the formula was altered, and made more intensive, with the result that a larger number of deaths occurred. A return was then made to the first formula, with some slight modification. Deaths still occurred. In explanation of the deaths, a general affirmation was made that the cases that died came "too late." But, in looking through the list of patients, I found that the cases which were "cured" were, in many cases, of just as long duration, and that with regard to them no assertion was made that they came "too late." Take, for instance, the case of Lord Doneraile. If, in his case, eleven days was too late for treatment, then all cases that

[1] Extract from an article by Thomas M. Dolan, M.D., in The Contemporary Review for July.

came after that period had elapsed must be expunged from the list of cures. Or, if Lord Doneraile's death was due to the application of the weak or first method, then the cases of the others treated by the same formula fall to the ground.

A yet further objection from the scientific standpoint is to be found in the fact that we know absolutely nothing of the action of these injections. M. Pasteur has not been able to tell us either the rate of absorption of each injection, or any thing of the physiological processes which take place.

In order to substantiate these objections, I shall throughout quote M. Pasteur's own words, and give his own statistics, and the names of his cases. The first point to which I must call attention is the remarkable classification which he has adopted with regard to the proofs that the patients he has treated were bitten by dogs that were really suffering from rabies. The following is the form adopted: Class A. Cases in which the dog was proved to be rabid by the experimental test; Class B. Cases in which the dog was recognized as rabid by the veterinary surgeon; Class C. Cases in which the dog was only suspected of being rabid.

This classification presupposes that all the patients have been exposed to danger. It makes no allowance for non rabid dogs, with the strange result, that, according to these statistics, a veritable epidemic of rabies affecting thousands of dogs must have existed in France during the years which have elapsed since M. Pasteur introduced his system.

It may be objected that in this matter the most eminent medical men in England support M. Pasteur. In reply to this, I will take one of the most eminent of these names, and show that his assertions with regard to the Pasteurian system are not supported by statistical, physiological, or pathological evidence. At a meeting at the Mansion House on Monday, July 1, 1889, Sir James Paget stated, that, "taking the average of all persons bitten by rabid dogs, 15 per cent would suffer from the disease, and 15 per cent would die. . . . In the seven thousand bitten, if fifteen of each hundred had died, there would have been as nearly as possible a thousand deaths, but only a hundred died. Pasteur has therefore saved already nine hundred lives." In the report of the English Hydrophobia Commission, Sir James Paget agrees with his co-workers in stating ' that at least 5 per cent of the persons bitten would suffer from the disease." We have therefore two estimates of 5 and 15 per cent as the mortality in the case of those bitten by rabid dogs. With each percentage we obtain a supposed increased saving of life.

In order to realize the value of these assertions as applied to the Pasteurian statistics, let us inquire carefully what was the mortality in France during the years before M. Pasteur took up his work; for it will be manifest that if this system saved nine hundred lives in five years, then there ought to have been an equal or proportionate mortality in France before the introduction of the Pasteurian system. The facts, however, are far otherwise. The illustrious Tardieu, in a report presented to the minister of hygiene in 1863, maintained that twenty-five cases of rabies per year approximately represented the mean mortality in France from that disease.

The following figures represent the mortality in France in each year from 1850 to 1872: 1850, 27; 1851, 12; 1852, 46, 1853, 37; 1854, 21; 1855, 21: 1856, 30; 1857, 13; 1858, 17; 1859, 19; 1860, 14; 1861, 21: 1862, 26; 1863, 49; 1864, 66; 1865, 48; 1866, 64; 1867, 57; 1868, 56; 1869, 36; 1870, 36; 1871, 14; 1872, 15. But these statistics may be objected to on the ground of their antiquity. I therefore give more recent statistics, furnished by one who is not unfavorable to the Pasteur system.

Dr. Dujardin Beaumetz, director of the Sanitary Service of Paris, has addressed to the prefect of police a report on hydrophobia in Paris, furnishing the following data of comparison:—

Four Years antecedent to Pasteur.	Deaths.	Four Years of Treatment.	Deaths.
1882	9	1886	3
1883	4	1887	9
1884	3	1888	19
1885	22	1889	6
	38		37

These figures represent the deaths in the Department of the Seine.

With such figures before us, what becomes of the statement of our distinguished surgeon, that M. Pasteur has by his system saved nine hundred lives, when the national statistics of France prove conclusively that in no five years, for a quarter of a century, preceding M. Pasteur's discovery, did any such number of people die from this disease. The statistics of other countries also negative the statement.

The remarkable effect produced upon the statistics of hydrophobia by M. Pasteur's discovery is yet more strikingly shown when we investigate the returns from the Paris hospitals. On Nov. 2, 1887, M. Pasteur wrote to the Academy of Medicine as follows: "We know that sixty persons have died in the Paris hospitals during the last five years, a mean of twelve per year." After careful investigation of the hospital returns for those years, I am compelled to contradict this statement, and I am prepared to submit to M. Pasteur a full list of the names of all the patients who died in the Paris hospitals during that time, showing the following results: in 1881, 11 died; in 1882, 3; in 1883, 4; in 1884, 3; in 1885, 5. This gives a total of 26, or an average of 5.2 per annum, in place of the annual average of 12, as estimated by M. Pasteur. I am able to give the full details of the number of French patients treated by M. Pasteur who have died since the introduction of the Pasteurian system. For the complete list of the names of the patients, with the date of the bite, date of treatment, and date of death, I am indebted to the energy and ability of Dr. Lutaud. Space will not permit me to give this list in full, but the following is a recapitulation: in 1886, 19 deaths; in 1887, 27 deaths; in 1888, 23 deaths; in 1889, 21 deaths; giving a total of 80, or a yearly average of 20. These cases only represent the deaths after inoculation by M. Pasteur. To obtain the annual mortality of rabies in France, we must add to the foregoing the deaths of those persons who have not been treated at the institute. According to statistics published by M. Pasteur himself in 1886, the deaths among the non-inoculated for that year amounted to 17. If these be added to the 19 who died after treatment, we have an annual mortality of 36, as against an annual mortality, according to Tardieu's returns, prior to the introduction of inoculation, of 25 to 30. With these statistics before us, we are forced to the conclusion that the words quoted from the address of our eminent surgeon at the Mansion House were prompted more by generous impulse, and by feelings of respect and friendship for Pasteur, than by any strict regard to statistical data. As we have seen, Sir James Paget fixes the general mortality of those bitten at 15 per cent. M. Pasteur, in his article in the *New Review* (December, 1889) accepts this estimate, but thinks it is too low for bites on the face and other exposed parts. In such cases he thinks that the figures should be from 60 to 90 per cent. If we add up the number who have been bitten on exposed parts, and accept these percentages, then M. Pasteur's saving of life has been much greater, and his cures for France alone amount to some hundreds per annum. When we remember the ascertained mortality in France, and the rarity of hydrophobia there in past years, such percentages as the foregoing reduce the system to an absurdity.

The good old Dr. Berkenhout, writing about rabies in 1783, told us that he knew not of any human attempt which had a better resemblance to the Knight of La Mancha's attack on a windmill than that of combating popular errors and reasoning against popularly received opinions. I have been at times disposed to accept this view, and have felt inclined to let popular fashion expend itself. When I first criticised the method of Pasteur, what I said was received with incredulity and positive disfavor; but as time went on, and many of my predictions were verified, the incredulity gave place to greater tolerance in regard to opinions expressed against the system. There was a complete change of front. The infallibility of the method was abandoned, and its apologists adopted another tone. "Pasteur's system was not perfect," they said. "No system of therapeutics was perfect. Pasteur would be an angel, and not a man, if he could, at one *coup*, bring rabies into subjection." "Give him time," said another. Yet another apologist appealed to the law of averages, and said. "Pasteur has reduced the mortality from 5 per cent to 1 per cent."

To M. Peter the world owes the first exposure of the dangers of

the intensive method. It required great courage on the part of Dr. Peter, Dr. Lutaud, and others in France, and Dr. B. W. Richardson in England, to oppose the fashion. Had they not been actuated by a pure love of science, they would have been silenced. It is, however, not unsafe to prophesy that the intolerance of the new school in France, as shown in its treatment of Professor Peter, will bring about its own downfall.

Have we any treatment, then, that is satisfactory, based on these discoveries? The only answer to this question must be an emphatic "No!" The clinical observer has been very patient, knowing that he could afford to wait. Professor Peter, one of the greatest of contemporary clinical observers, and the worthy successor of Trousseau, has endeavored to save medicine from the reign of terror formed by the coterie which, in the name of science, anathematized all who ventured to doubt their theories. "You are unscientific," said the coterie; "you do not believe in our methods of modern research, and you cannot have a hearing." This kind of language has silenced many, because, when there is a fashion, men foolishly imagine that they will be looked on as progressive if they go with the tide. Martyrdom is not so eagerly sought after; and social ostracism is the penalty, too often, for appearing in a minority, as did M. Peter at the Academy. Clinical observers may, however, take heart: there are signs that the cloud will lift, and that medicine will yet be emancipated from the trammels of what has been so well called "vaccinomania."

BOOK-REVIEWS.

Advanced Physiography. By JOHN THORNTON. London and New York, Longmans, Green, & Co. 12°. $1.40.

THIS book treats of advanced physiography as defined by the syllabus of the Science and Art Department of South Kensington, London. It embraces a concise statement of astronomy; an account of the size, shape, and density of the earth; a brief consideration of atmospheric and oceanic movements and of terrestrial magnetism; and some mention of certain other things on which questions might be asked in the science and arts examinations. Several sample examination-papers are appended, so that the student may, as it were, see what he is studying for. The examinations certainly are of value, and tend to turn school studies in directions approved of by competent educators; but, when it comes to writing a book to meet the examinations, the lover of pedagogics may well rebel. Mr. Thornton has done his task conscientiously. He has searched through good works for his materials, and has said something of every thing that the most ingenious examiner could ask about, and said it concisely and well, as a rule. He has avoided the staleness of old text-books, and has introduced many results of recent investigations; but, for all this, his book still leaves the impression of leading its students to South Kensington, rather than to good mental training. Moreover, the frequent wholesale quotation from other text-books gives the impression that the author is too greatly a compiler, and too little an investigator. In these modern days, when the preparation of school-books is considered worthy work for the director of the Geological Survey of Great Britain, for the superintendent of our Nautical Almanac Office, and for other eminent scholars, it makes us a little impatient to meet a book that is so distinctly a compilation as this one is; but perhaps we lay too great emphasis on this point. Books on physiography, as here defined, must be in great part compilations.

If not an investigator, the author is evidently a practised teacher; and his chapters, paragraph headings, and illustrations show an aptitude in methods of statement and explanation that must bear good result. The careful account of the different methods of finding the masses of the planets, the full description of modern spectroscopy, and the extended chapter on comets and meteors, may be cited in evidence of this. The accounts of the tides and of the winds are distinctly less successful. Occasional lapses appear, such as, "Heat and light are forms of radiant energy," or as latitude being shown as an angle at the centre of the earth, or as making our tornadoes identical with West Indian hurricanes and Chinese typhoons; but errors of even this minute kind are not common. Condensation of statement in certain chapters will either leave much work for the teacher, which is not objectionable if he is equal to it, or will leave the scholar in a very confused state of mind; and this leads back to our starting-point, that a book prepared to enable students to meet examinations is not the best kind of a book for securing intellectual training.

Graphical Statics. By LUIGI CREMONA. Tr. by Thomas H. Beare. Oxford, Clarendon Pr. 8°. (New York, Macmillan, $2.25.)

THOSE who are accustomed to make use of mathematics as a tool, and who are not able to ascend into the higher regions of pure mathematics farther than is necessary to secure their practical ends, especially the engineer seeking the solution of the problems in kinematics and in mechanics that come to him in the course of his regular professional work, often have occasion to remark upon the extremely limited range of problems which are capable of solution by algebraic processes, and upon the greater effectiveness of the geometric methods. A glance at any treatise, on any branch of engineering, will show how narrow is the field of application of the algebraic systems to the practical work of the constructor. Where the elements are few, the conditions very simple, and the results sought similarly easy of expression, algebraic methods come in play; but, as in astronomy, the introduction of a little wider generalization, of a single new condition, often carries the problem entirely outside the field of application for the algebraist. Algebra does marvellous work, but its limits are soon reached. Graphical methods are often found to be far more satisfactory, not only in their ease of application, but in the readiness with which the results may be comprehended and translated into the language, and represented by the work of every-day practice. Thus it happens that "graphical statics" has come forward, within a very short time, as the most valuable tool of the engineer.

The father of the system, in some sense, is the well-known Culmann, whose treatises have been translated into English by Dubois; but some work had been done even before he attempted collating and systematizing it. Rankine did much in this field; and many minor writers have added, each his mite, to the subject. We observe that Cousinery is credited with many contributions to the subject by the writer of this latest treatise. Professor Cremona begins by the presentation of the system of signs adopted, in which he follows Moebius, and then takes up the work in the usual way, giving the standard methods of arithmetical treatment, the graphics of the four rules; the discussion of the processes of graphical involution and evolution; the solution of numerical equations; and the discussion of the centroids. The second part consists of a discussion of reciprocal figures, including Rankine's theory of structures and polygonal frames, and Culmann's work in the same department. The work is well written, the system satisfactory, and the methods in detail logical and exact. Professor Beare is entitled to commendation for his admirable translation; and both he and its author deserve much from the English-speaking reader and student of "Graphical Statics."

Like all the work of the Clarendon Press, the book-making is excellent, and deserving of all praise.

Cycling Art, Energy and Locomotion. By ROBERT P. SCOTT. Philadelphia, Lippincott. 12°.

THIS is an interesting little 12mo treatise on the art of the wheelman, which, in a space of three hundred pages, gives a good historical summary, and an account of the later forms of the wheel, and of the principles of their construction and operation, and presents the mathematical and scientific principles of their balancing and propulsion. One of the most interesting chapters in the book is that in which the author gives the graphical measurements obtained by him with an autographic apparatus devised by himself to record the resistances to the motion of the machine and the pressures of the foot on the pedal. Exact knowledge on these points has not heretofore been obtainable, and this investigation is a real contribution to our knowledge in this field. The

"cyclograph" will undoubtedly do much service hereafter. An analysis of the motions of the machine as it passes over obstructions is also likely to prove of value in the promotion of safety, and in the elimination of the "header" from the list of casualties.

A chapter on ball-bearings includes a discussion of the subject by Professor S. W. Robinson, which is a valuable contribution, especially as giving the limit of weight allowable for balls of any given size. The co-efficient of friction for a one-inch ball is given as about 0.00175, as derived from experiments upon the Lick telescope. The book is full of interesting information for the wheelman, and abounds in good reading for all those who are interested in the subject.

Steam. By WILLIAM RIPPER. London and New York, Longmans, Green, & Co. 12°.

THIS is a little primer of steam and the steam-engine. It is a reproduction of notes of lectures addressed by its author to an evening class of young "mechanical engineers" (the term is evidently not applied to the class usually considered to be represented by it in this country), and includes a course of discussions of steam-engines, boilers, and accessory subjects.

Within these two hundred pages are compressed the best compendium of the subject that has yet been published. It is also, so far as we have been able to discover, accurate, and is evidently written by an engineer familiar with the science and the art, and not, as is too often the case where these primers are produced, by an amateur or tyro hardly more familiar with the subject than those to whom his instruction is offered. A preliminary discussion of the physical properties of steam, the chemical principles of combustion, and the elements of thermodynamics, is followed by a brief description of the modern steam-engine, its construction, and its performance, which is really of value, and might well repay the professional for the time required to read it. The book is well illustrated, in the sense of having a good list of engravings, though their quality as specimens of the engraver's art may not be reckoned high, in the opinion of the expert. The compound engine is described, and its principles summarized, and the book is concluded by a chapter on the management of engines and boilers.

AMONG THE PUBLISHERS.

WE have received No. 30 of "Odds and Ends from the Literary Junk Shop," by A. S. Clark of 34 Park Row, this city.

—"Education as a Factor in Civilization" is the title of an essay by Caroline B. LeRow in the *Modern Science Essayist* for June 15. In the issue of July 1 John W. Chadwick treats of "Evolution and Social Reform," dealing mainly with "The Theological Method."

— Painters—and by this we mean artists, and not carriage or house painters—are not, as a class, persons likely to take interest in the chemistry of paints and painting. Yet it appears that the Royal Academy of Arts in London has a professor of chemistry in the person of A. M. Church, a master of arts, and fellow of the Royal Society; and this same Professor Church has written a "Chemistry of Paints and Painting," which is published in New York by Macmillan. The book is intended for those who use paints, and is meant as a help, that paints and varnishes may be well chosen and properly used. It is not expected that any one will read the book through, but that information will be sought within its covers as occasion may occur. It has therefore happened that to some extent the same matter has been inserted under more than one heading in the book. The book is unique in its field, and should be available to all likely to be interested.

—Mr. Arthur H. Noll has written "A Short History of Mexico," which has been published by A. C. McClurg & Co. of Chicago. The author states in his preface that he has been unable to find any comprehensive history of Mexico in the English language, and he has accordingly endeavored to make up the deficiency. We wish we could say that he has succeeded; but in fact his work is extremely unsatisfactory. He has no intelligent concep-

tion of what history is, his narrative being little more than a brief account of the various viceroys, generals, presidents, and other administrators, that Mexico has at different times had. He gives no information of any value about the condition of the people at any period; he tells us little or nothing about the civilization of the Aztecs, though he relates a good deal of their legendary history; he fails to describe the mode in which the Spaniards governed the country, and he leaves us completely in the dark as to the history of legislation and the moral and material development of the Mexican nation. A good history of Mexico is still a desideratum.

—An important work by Dr. Daniel G. Brinton will be published in a few weeks by N. D. C. Hodges, 47 Lafayette Place, New York. The book, which will be entitled "Races and Peoples," will be a review of the whole domain of ethnography, with particular attention to the white or European race, the Aryan peoples, their origin and distribution. The latest opinions of the leading European scholars have been consulted, but the work is largely the result of independent research, and does not follow any especial school of ethnographers.

—G. P. Putnam's Sons have in press for early publication "The Trees of Northeastern America," by Charles S. Newhall, with an introductory note by Professor N. L. Britton of Columbia College, which describes all the native trees of the northern United States east of the Mississippi, as well as mentions the more important naturalized species, with illustrations made from tracings of the leaves of the various trees; "Gustavus Adolphus and the Struggle of Protestantism for Existence," by C. R. L. Fletcher, in the Heroes of the Nations Series; "The Jews under the Romans," by the Rev. M. Douglas Morrison, in the Story of the Nations Series; "Dust and its Dangers," by Dr. T. M. Prudden, written with the purpose of informing people, in simple language, what the real danger is of acquiring serious disease, especially consumption, by means of dust laden air, and how this danger may be avoided; "Among Moths and Butterflies," by Julia P. Ballard, a well-written book, on an interesting subject, for young people; and a new and popular edition of "Seven Thousand Words often Mispronounced," which has proved one of the most successful of Phyfe's books. They have also under way "Tabular Views of Universal History."

—The *Nation*, with its issue of July 3, enters on its twenty-sixth year of publication. It was started with the intention of supplying the educated public of America with political and literary criticism of a somewhat higher order than that previously in vogue. We had had, indeed, much good literary criticism in some of our magazines, but political discussion in the newspapers had not been so thoughtful or so independent as it should have been. The *Nation* took a perfectly independent stand from the first, and has maintained it ever since. Its articles, too, especially on political and economical affairs, have been distinguished by greater depth of thought than those of most American papers, and, though its superiority in this respect is not relatively so great at the present time, it still maintains a high rank. It has honorably distinguished itself by its advocacy of political honesty and sincerity, and by its support of certain special reforms, those of the tariff and the civil service being the most prominent. Its chief fault is a certain cynical tone and inclination to fault-finding, when something different would be at once more agreeable and more effective. Denunciation of wrong-doers is sometimes necessary; but it has no such efficacy as those who indulge in it are apt to suppose. Since its consolidation with the *Evening Post*, the character of the *Nation* has been to some extent changed; yet it continues under the same management as before, and its fundamental characteristics are still preserved. We wish it a continued career of prosperity and usefulness.

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PROTOPLASM AND LIFE.

By C. F. COX. 12°. 75 cents.

The author of this book was for some years president of the New York Microscopical Society, and in this volume he sets forth his views on the spontaneous generation theory and its relation to the general theory of evolution, and on protoplasm and the cell doctrine.

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THE CHEROKEES IN PRE-COLUMBIAN TIMES

By CYRUS THOMAS. 12°. $1.

Dr. Thomas in this work will reverse the usual method of dealing with prehistoric subjects; that is to say, he will commence with the earliest recorded history of the tribe as a basis and trace the chain back step by step by the light of the mounds, traditions, and other evidence, as far as possible. He has already presented to the public some reasons for believing the Cherokees were mound-builders, but additional evidence bearing on the subject has been obtained. A more careful study of the Delaware tradition respecting the Tallegwi satisfies him that we have in the Bark Record (Walam Olum) itself proof that they were Cherokees. He thinks the mounds enable us to trace back their line of migration even beyond their residence in Ohio to the western bank of the Mississippi. The object is therefore threefold: 1. An illustration of the reverse method of dealing with prehistoric subjects; 2. Incidental proof that some of the Indians were mound-builders; 3. A study of a single tribe in the light of the mound testimony. This work will be an important contribution to the literature of the Columbian discovery which will doubtless appear during the coming two years.

THE TORNADO.

By H. A. HAZEN. 12°. $1.

Professor Hazen is one of the prominent meteorologists connected with the United States Signal Office. In this work he reviews our present information as to tornadoes, severely criticising some of the opinions held in regard to them up to this time. No one has given a more careful study to these destructive storms than has Professor Hazen, and his book will prove a decided contribution to the world's knowledge. In this book will be found a careful discussion of the important question of Tornado Insurance now attracting so much attention. Hundreds of dollars may be saved by people who are thinking of such insurance by following the principles here made plain.

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A GENTLEMAN of experience, highly recommended, liberally educated at home and abroad, desires to correspond with parties needing an instructor in the classics or modern languages in a high grade institution. Address EARLHAM, Germantown, Pa.

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A YOUNG MAN, graduate from an American College, who has studied a year in Germany, and is now studying in Paris, would like professorship in chemistry. References from some of the best chemists. Address CHARLES E. LINEBARGER, Post-Restante, Paris, France.

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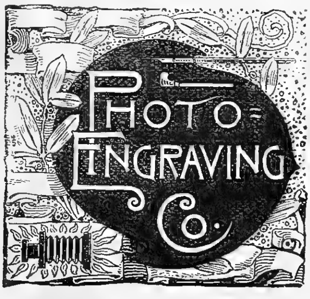

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SCIENCE

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SUN-SPOTS AND PREDICTIONS.

ATTEMPTS are continually being made to connect terrestrial weather and storms with the motions and positions of the moon, the planets, and the sun. It has been fairly well shown that at the time of full moon there is a tendency, in some parts of the world, toward a diminution of clouds. One computation has shown a slightly greater rainfall during new moon on the Atlantic coast, but precisely the contrary on the Pacific coast. There has also been a very slight evidence of the increase of thunder-storms at the new moon. The influence of the planets must be absolutely inappreciable. When we consider the sun, however, we see at once the intimate connection between his radiant energy and all activities upon the earth. The growth and well-being of every living thing are absolutely dependent upon the sun's light and heat. It is believed by many that the sun's heat is the only agent to be considered in seeking for an explanation of our storms and all our weather changes. It is undoubtedly true that some form of solar energy is concerned in our storms, but it would be quite hazardous to say that electric influences from the sun are not far more potent for producing storms than even its heat. As the sun's heat is the most prominent energy recognized by our senses, every attempt has been put forth to determine whether this is constant as regards our climate, or whether there are fluctuations at long intervals. It is plain that these changes, if they exist, cannot be appreciable to our thermometers for centuries. The difficulty of measuring the intensity of solar rays by direct observation has been practically insuperable; and we may say that the total amount of heat which we receive is so great, as compared with its fluctuation from the greatest to the least, that we cannot hope for any definite solution of that question for years to come.

Coincidences.

In seeking any relation between the sun's light, heat, rotation, or appearances, and terrestrial phenomena, it is unsafe to trust to mere coincidences; but some connection of cause and effect should be established. For example: on Aug. 3, 1872, while Professor C. A. Young was examining the solar prominences with a telescope, he saw a most violent outburst upon the sun, and noted the exact instant when it occurred. Afterwards he found that his assistant at that very moment had observed a violent agitation of his magnetic needle; and an examination of the records at Kew, England, revealed exactly the same disturbance of the needle there. This may safely be regarded as more than a mere coincidence, and proves, in connection with other observations of a like nature, the intimate relation between solar disturbance and terrestrial magnetism.

It is well known that the sun is periodically spotted; that is, once in about eleven years spots gradually appear, and increase near the sun's equator. A remarkable fact about these spots is that their motion very near the sun's equator appears to be faster than in higher latitudes They revolve or come in sight in a little over twenty-five days in the former position, and in about twenty-seven days in the latter. This single fact should lead a great many of those who believe that our tornadoes are produced just as the spots appear by rotation, or about twenty-six days apart, to doubt the sufficiency of the explanation, because any such periodicity would be entirely broken up from the variable rotation period of the spots. The cause of these spots has not been well established, but it is probable that they are the result of increased electric activity on the sun. The attempt to connect this eleven-year period with our weather has proved intensely fascinating, and volumes of researches have been published. Such comparisons have proved, in the main, very illusory. While an apparent connection would be found in a few periods, yet, as the number of observations increased, the supposed connection was disproved. A single illustration will suffice. The attempt has been made repeatedly to connect the sun-spot period with fluctuations in temperature. In the nature of the case, it is impossible, perhaps, to prove whether the spots show the sun to be hotter or cooler during their existence. The fluctuations of temperature on the earth certainly do not show a preponderance either way, when compared with the appearance of sunspots. This does not necessarily prove, however, that the spots do not influence our temperature, or that they do not show increased heat in the sun; for this increased heat would tend to produce clouds from a greater evaporation, and these in turn would prevent the sun's rays reaching the earth, and this would result in a cooling rather than a heating, which would mask the spot influence (see *Monthly Weather Review*, January, 1888).

Auroras.

Research has shown conclusively that our auroras and magnetic storms have an eleven-year period, and this is coincident with spot fluctuations; that is, as activity in spots increases, our auroras increase, and *vice versa.* It has also been definitely settled that the aurora is an electric phenomenon, and is intimately connected with magnetic storms on the earth. Here we have practically a number of coincidences which may be said to prove a definite connection between these phenomena without a positive knowledge that

they are both produced by a common force, or that the spots produce the effect upon the earth. The coincidences here, however, are very marked, and there are practically no discordances. These points should be most carefully borne in mind in all our studies in this line.

Sun-Spots and Storms.

Meldrum of Mauritius was one of the first to study the relation between cyclones and sun-spots, and found that during the three maximum periods of the spots between 1848 and 1871 there were nearly twice as many cyclones as during the minimum periods. The evidence in 1871, however, was far less than in 1848, and the more recent spot maximum of 1884 showed no increase in cyclones; so that this proof, which has been *the* one that has been relied upon above all others, has gradually dwindled down to practically nothing. It should be noted, however, that we have no absolute proof one way or the other; for during the spot maxima of 1871 and 1884 there may have been other forces acting which tended to diminish the activity of cyclones, or to divert them from the track of ships whose records Meldrum examined. Poey examined the West India cyclones, going back to 1750, and he thought that there were more cyclones during spot maxima. This record is so long that I have deemed it worth while to give it a careful study. The spot curve is remarkably well defined, with very few irregularities. The maximum and minimum points are very easy to find, and one can have no doubt as to the exact year of each period. The cyclone curve, on the other hand, is exceedingly irregular, and fluctuates back and forth across the spot curve. Comparing the cyclone and spot curves, I find that in the twenty-four maximum and minimum periods there are eight coincidences, ten positive discordances, and six doubtful cases (that is, cases which showed a flat curve for cyclones at the time of either maximum or minimum spots). This is a very poor showing, and certainly proves no intimate relation. No one can compare these curves and consider that the relation is proved by them.

If it could be shown that our cyclones were due to special heat or electric action, and that sun-spots tended in the same direction, there might be some hope in establishing a relation between them. Under the circumstances, however, it is necessary either to obtain accordance or else to explain away the discordances. Coincidences for a few periods are very probable, and prove nothing. The weakness of this cyclone research lies in the fact that only very limited portions of the earth have been considered. The only proper way would be to determine the extent of storm activity over the whole globe each day of the year, and then to compare this with sun-spot action. The reasons that many sun-spotists have met with so much encouragement in their researches have been two: 1. A "coaxing," as Professor Young puts it, of the critical point of a sun-spot period (that is, if the cyclone maximum came two or three years earlier or later than the spot maximum, it has been regarded as a coincidence); 2. A consideration of all manner of terrestrial disturbances as fulfilling the prediction or establishing the coincidence. All manner of tornadoes, storms, blizzards, hot waves, cold waves, floods, frosts, earthquakes, etc., have been drawn into their nets. It would seem that this practice should be regarded as very unreliable. If a spot produces a cold wave one week or at one time, it can never produce a hot wave at any other time. The determination of such a relation, if there be one, is one of the simplest mathematical processes that can be imagined, after the data are at hand, and yet the sun-spotists are very anxious to make their own computations. One of them writes, "I am very much afraid you will coax the data to disprove my view." It is very plain that no accurate research of this kind can ever be made by any one that cannot be repeated by any other person, and the fear of sun-spotists to have the verification of their theories taken out of their hands is well grounded.

Tornadoes and Sun-Spots.

If we take such a very great territory as that of the United States, and have stations at every sixty or a hundred miles, then count the number of stations each day at which the wind velocity reached twenty miles or more per hour, we would have a partial view of the average storm activity each day of the year. Again: if we could get a record of every violent storm in this region, and give it a proper weight, we would have a fair idea of storm activity, and could compare it directly with the known and easily measured spot activity. This has been done with the 2,221 tornadoes that have visited this country. The following table shows the relative intensity of tornadoes by weight, and the relative sun-spot intensity:—

Year.	Tornadoes.	Sun-Spots.	Year.	Tornadoes.	Sun-Spots.
1873........	8	701	1881.......	169	730
1874........	15	601	1882.......	286	1002
1875........	69	272	1883.......	589	1155
1876........	68	122	1884.......	461	1079
1877	111	92	1885.......	374	811
1878........	108	24	1886.......	243	527
1879........	92	49	1887.......	183	[300]
1880........	269	416	1888.......	259	[100]

In this table, numbers in the sun-spot column are taken from the Greenwich photographs, and show the relative area covered by spots in millionths of the sun's surface. The earlier tornado records are in some doubt, as they are quite meagre. The enormous increase in both tornadoes and sun-spots during 1883 and 1884 is very striking, and seems to be a fact, though it will require several more eleven-year periods to establish the coincidence. There was an increased activity in collecting tornado data in 1882, but this continued through till 1887; so that the great increase in the two years above cannot be ascribed to this cause. Moreover, the list of 2,221 tornadoes was made up chiefly from the same source throughout all the years. There is a quite strong proof that the sun-spots are due to the action of electricity. Now, it has been shown that our tornadoes have an abundance of electric action, so that there is no inherent improbability in the supposition of a relation between these phenomena, aside from a mere coincidence in their phases.

Specific Influence of Spots.

If such a relation exists, some have thought that there ought to be a synchronism between the appearance of spots and resulting storms. The view has been strenuously sup-

ported, that within two or three days after the appearance of a spot on the eastern limb of the sun, or by the rotation of the sun, storms break forth or greatly increase in violence on the earth, and that it would be possible to use this fact in making predictions of violent storms. It will be easily seen that this view, if true, is of the extremest importance. No attempt is made to explain why it is that after two or three days this spot influence dies down, while the spots are still in full view of the earth for ten days. Since electric energy is transmitted at once from the sun, why should it not begin its action at once upon the earth? We must remember that this action is not a direct one, but electricity must act first upon the clouds or atmosphere, and possibly these upon the earth in turn, before the storm is produced or influenced; so that there need not be a direct connection between the two. The reason that this hypothesis has gained in favor has been already explained, and lies in ignoring discordances and emphasizing coincidences. Our curve of tornado activity furnishes a most extraordinary means of determining this specific effect of spots, if there be such.

The Greenwich, India, and Mauritius photographs of spots show exactly the appearance of each spot by solar rotation, and its area, or, as we may say, its relative intensity. We can easily determine, then, the activity of spots on the eastern limb of the sun during any day. It will be seen that this process is very dissimilar to the one adopted in obtaining the annual intensity; for that used the spotted area over the whole sun each day, while this method uses the area of a spot for three days only, and immediately after its first appearance by rotation. The years 1874 to 1886 were used, and the tornado months March to September. Curves were constructed showing both the spot and tornado activity for each day of the above period. An examination of the curves showed, (1) 46 tornadoes coincident with spots, (2) 156 spots without tornadoes, and (3) 393 tornadoes without spots: 46:593, or 8 per cent, which is insignificant. Next there were compared three successive days of spots, and the same days of tornadoes, during the extremely abundant tornado years 1882 to 1885 and the months April to August. It will be seen that in this comparison every thing was in favor of the tornado and spot-rotation hypothesis. There were 43 coincidences, 30 spot groups without tornadoes, and 79 tornado groups without spots: 43:109, or twenty-eight per cent. It is plain that this hypothesis breaks down completely under this investigation.

General Influence of Spots.

On observing the sun-spots carefully, we find that there are marked periods during which the spot activity increases and diminishes. In order to compare such periods with tornado activity, curves of both were drawn; and it was found that while a rise in the tornado curve occurred during the greatest activity of spots, yet the converse of this proposition was not true, for there might be a rise in the spot curve without a response from the tornado curve. This may have been due, as has already been suggested, by the masking of the spot effect at the earth's surface. The evidence, while showing a tendency to increased tornado action during an abundance of spots in at least one eleven-year period, does not show any marked specific action or relation between any definite spot phenomenon and a corresponding response by storms on the earth. The subject is exceedingly complex, and merits further study, especially in the line of a removal of any outside influences which would tend to mask the influence of spots at the earth.

Predictions.

It has been said that one of the best tests of the advancement of a science is its power to make predictions. Unfortunately, weather science has easily lent itself to all classes of wise or simple persons, and has suffered by their ignorant attempts at foisting upon it crude and imperfect forecasts of the future weather. An interest attends some of these efforts, however, from their curious and incongruous medley. Witness, for example, the famous lines of Dr. Jenner, beginning

> "The ass begins to bray,
> We shall have rain to-day,"

now so universally quoted. Many of these signs have a real significance: for example, the very old saying, "When it is evening, ye say, 'It will be fair weather, for the heaven is red;' and in the morning, 'It will be foul weather to-day, for the heaven is red and lowering.'" It has been suggested already that much may be learned from cloud appearances to assist in determining the probability of a tornado. A peculiar livid and greenish color is often seen, or ragged and angry-looking clouds in the west announce the greater disturbance. The appearance of lightning and heavy thunder usually precedes the tornado, though of course both these may be followed by an ordinary thunder-storm. The loud indescribable roar is unmistakable as a precursor of the funnel-cloud.

The question is often asked, however, "Can there be a prediction of a tornado a day, week, year, or even a century, in advance?" This problem has been most exhaustively studied by so-called weather prophets, and the public have been not a little mystified by the varying claims put forth by each prophet, and especially by the extraordinary success in such predictions that these men insist they have had. The scope of this paper will not permit more than an outline of these theories; but we may lay down certain rules that should guide us in estimating the value of such predictions, and in putting our faith in them. The moon, the planets, and the sun have been the most potent factors in these theories of storm-formation.

The Moon's Influence.

The comparative nearness of this body, and the fact that its phases occur in about seven days, which is approximately the interval for the occurrence of storms, have made it one of the most popular influences for weather changes. Soon after the death of the elder Herschel there appeared a singular set of weather tables ascribed to him, and purporting to give weather predictions according to the age of the moon. These tables have been scattered broadcast over this country. It is needless to remark that Herschel had nothing to do with them, as has been shown by his son. The moon is an inert mass, and can have no influence on our weather, except, as we have just seen, it has a very slight tendency to drive away clouds. Observations have shown that the tide produced by the moon in our atmosphere is only four-thousandths of an inch of mercury.

Planetary Hypotheses.

If the moon, only 250,000 miles away, has no marked influence on our weather, what must we think of the effect of the planets, millions of miles away? It is no wonder that at least one of these prophets, after giving the whole subject careful study, was forced to abandon the planetary hypothesis for the lunar theory. There is nothing which shows the utter absurdity of these planetary theories more forcibly than the introduction of the hypothetical planet Vulcan. This is needed in order to have a body revolving around the sun frequently enough to make his position relative to the earth coincident with our numerous storms. One of these prophets, an American, thought he saw Vulcan passing across the sun, and published a careful computation indicating, that, according to Le Verrier's orbit, the planet should have been exactly at that point; but, unfortunately for this hypothesis, it was shown by Professor Proctor, that, owing to a slight inaccuracy, this computation was wrong, and that this prophet, if he saw Vulcan at all, must have seen it directly *through the sun*, on the opposite side from the earth. Granting that there is a planet only 8,000,000 miles from the sun, and about 85,000,000 from us, is it not perfectly plain that its influence on terrestrial weather would be most completely overshadowed by the all-powerful sun behind it?

It is not a little remarkable that these prophets are entirely disagreed as to how this planetary effect is produced. One would have our storms and tornadoes coincident with the equinoxes of the planets, another with their oppositions and conjunctions; and so on. It is easy to see, that, under these circumstances, no two of these prophets agree on the dates of storms, but they are distributed quite uniformly for about half the days in the year. How does it happen, that, though these dates disagree, all these prophets are perfectly satisfied as to the exact fulfilment of their predictions? This is very simple to explain; for the man who predicts a storm on the 1st of the month, for example, verifies by a storm, say, in Illinois, while the one who has put his storm on the 3d of the month verifies by the same storm, which has now moved to Maine. There is just one crucial test by which we may satisfy ourselves of the worthlessness of these theories. It has been outlined in the last chapter. Let these prophets make a careful study of all the influences they can muster, and put down, no matter whether for the past or the future, the dates when they would expect the worst storms, and also the dates of fewest disturbances, then take the whole extent of this country, and establish the dates of most and least atmospheric disturbance. A comparison of these dates would quickly prove the value of such predictions. It is needless to add, that frequent and continued attempts to obtain these dates from at least four of these prophets, and to get any one of them to agree to this comparison, have lamentably failed.

There are not a few people who put great faith in such predictions, though a moment's thought would show how preposterous the claim is. For example: the Louisville tornado, on March 27 of the present year, was heralded as a perfect verification of a prediction for storms from March 28 to 30, and pains were taken to spread this fact from Maine to California. Suppose some one in the tornado district had read this prediction on March 27, and put faith in it: would he not have been misled? Again: if some one in Maine had read the prediction, would a storm in Kentucky apply to his locality? It is so easy to make a storm prediction, and so easy to verify it if one is allowed his own way, that there is no immediate prospect of silencing these prophets; but it is to be hoped that our citizens will study this matter for themselves, and before long obtain right views. It is plain that such a prediction made years beforehand can have no influence on right-thinking persons, for we know that it is impossible to predict the weather with certainty for even twenty-four hours.

Since 1872 it has been known that tornadoes and severe storms occur in the south-east quadrant of a depression system as it traverses the country, and in the history of the Signal Service frequent predictions of such storms have been made. A great deal of discussion has arisen as to the possibility of extending this system, and of giving ample warning of these outbursts. The most that can be said at present is, that the occurrence of such a storm is exceedingly rare; and in a very small space, while we may be able to indicate a region of several thousand square miles where such local outbursts may be expected, yet little more than this can be hoped for. People living in such districts, when they hear of the prediction, should not be disturbed, but simply take it as a probable occurrence at possibly one or two places, and in any particular locality should be guided by the appearance of clouds and other threatening signs which have become familiar. In fact, the question frequently arises as to whether it would not be better to omit such a prediction entirely; but if the right view be taken of it, that it is a warning to look out, and not a positive statement, no one should be unduly disturbed.

There are times when there seems to be an unusual amount of electricity present in the atmosphere, and when these severe storms occur without presenting any indication whatever on our maps or in our reports. It is impossible, from our present telegrams and knowledge of these storms, to make any predictions in such cases, though we may hope that in the future we may have a clearer idea of disturbed conditions at one or two thousand feet above the earth, which will enable better predictions. Such storms are not very severe as a general thing. A storm region like that in Kentucky on March 27, 1890, is plainly indicated on our maps, and predictions of severe local storms were sent all through that region nearly twelve hours in advance.

There has been a gradual development in these predictions as the conditions have become more familiar. One of the later attempts was made in 1884, and in this case the whole country east of the 102d meridian was divided into eighteen districts, and private predictions were made each day during the tornado season as to whether or not a tornado would occur in any district. The claim was made that in this case 97 per cent of the predictions were successful, but a serious fallacy in these attempts was soon pointed out. To say that on any day in New England, for example, there would be no tornado, was no prediction at all; for only under most extraordinary conditions, occurring once in three or four years, are any tornadoes experienced there. Several verifications of these predictions according to mathematical principles gave from 13 to 20 per cent of success. This does not indicate, however, the measure of skill that has been at-

tained in tornado prediction, but was due primarily to an injudicious system of predicting, and secondarily to an improper estimate of the nature of the problem. It would be impossible, of course, to say that such a tornado as that at Grinnell in 1882, and the recent one at Louisville, would occur in any district. All that we can do is to predict a disturbed region. In verification, it would hardly be fair to adopt principles which could be used in determining the skill of a marksman shooting at a target, for example; but we must take into account the knowledge we have already gained of the relative violence and the manner of occurrence of such storms. We must determine, on a scale, the number of violent storms occurring in any district where such storms were predicted, and not confine attention to the most violent alone. To draw an imaginary line, and say that if a storm occurs within five miles of that line, in a district where it was predicted, it shall count fully as a success, but if it occurs five miles on the other side of that line it shall count as a total failure, is to impose restrictions upon the problem which seem entirely unreasonable.

In a study of tornado predictions made by Mr. Finley for June, 1885, the present writer assumed "that violent storms occurring, in any district predicted for, half way between the centre and edge, shall have weight 1; in the rest of the district, $\frac{3}{4}$; to the centre of the next outlying district, $\frac{1}{2}$; to the edge of that district, $\frac{1}{4}$; all outside of these, 0" (see *American Journal of Science*, August, 1887, p. 129). The percentage of skill attained as thus measured was 49. Mr. Curtis, taking the same predictions and discussing them mathematically, found 14 per cent. Mr. Curtis has more recently (1887) adopted somewhat the method suggested above, and obtained 40 per cent. These percentages, however, mean very little as to showing a real knowledge of the probable occurrence of tornadoes, for it is necessary to radically change the system of predicting. It would seem wiser to determine as nearly as possible the central point of any probable disturbance, three hundred or four hundred miles to the south-east of a general storm, and then give boundaries more or less definite to the violence of the storms. This we are able to do from what is known of the behavior of such storms. In verifying, we should consider all the storms that occurred, and give weights corresponding to their distance from the centre of the disturbed region, and to their intensity.

Tornado Photographs.

One of the most recent developments in tornado studies has been a strong desire to photograph this extraordinary appearance. It is very unfortunate that this desire has become so strong that unscrupulous persons have resorted to photographing sketches of tornadoes, and selling them for the real article. It is also unfortunate that all these alleged photographs have been made at distances of from ten to twenty miles. It is a great desideratum that we have many photographs taken at much closer quarters, and this is not so impossible as might at first sight appear. It would be useless for any one to attempt a photograph on the south side of a tornado within a thousand or fifteen hundred feet; but on the north side we have repeated authentic observations of persons who stood within one hundred and fifty feet, and did not feel any violent wind. It is much to be hoped that a photographer will catch, by his instantaneous flash, one of these monsters as it passes just south of his position. It will require more than the usual amount of bravery to do this, however, as is very plain.

Alleged Photograph.

While nearly all these photographs show quite plainly their origin, yet there is a single exception in a picture representing an alleged tornado near Jamestown, Dak., on June 6, 1887, recently published in a prominent magazine. There is no doubt that this is a genuine photograph. There exist most serious difficulties in regarding it a tornado-cloud, however. The picture shows a dense mass of cloud extending from the trees at the earth up to the uniform veil of cloud above, with clear sky on either side. This mass has a thickening on the right-hand side, and this is supposed to be the tornado. The appearance is exactly that of a cloudburst, as has been often witnessed, and not at all of a tornado. The dimensions of the camera and the distance of the cloud give the height between two and three miles. The distance of the cloud was variously estimated from eighteen to twenty miles. There was no destruction, and no one saw it, at the spot where the tornado was supposed to be. The only way it could be located was by following two lines of sight of persons from ten to fifteen miles away until they crossed. Drawings of a sand-whirl, not far from the alleged tornado, showed a funnel-cloud, and nothing at all like this indefinite mass in the picture. The evidence is quite conclusive that on this day there were in this region several appearances simulating cloud-bursts, tornadoes, and sand-whirls. It is very probable that this photograph was that of a cloud-burst within two or three miles of Jamestown. It is highly improbable that either a cloud-burst or a tornado ever had a height exceeding two or three thousand feet. A photograph of a funnel-cloud showing details, and especially two or three photographs taken as the cloud comes up and passes by, would be of the highest interest, and invaluable at this stage of our studies.

H. A. HAZEN.

NOTES AND NEWS.

THE Norwegian Storthing, by 73 votes against 39, has voted a grant of 200,000 kroner for Dr. Nansen's north pole expedition, says *Nature*.

—The third international shorthand congress will be held at Munich from Aug. 7 to 17, says *Nature*. The centenary of F. X. Gabelsberger, the originator of modern German shorthand, will be celebrated by those who attend the meetings, and a bronze statue of him will be unveiled.

—The Entomological Club of the American Association will meet at 9 A.M., on Wednesday, Aug. 20, in the room of Section F, State House, where members of the club will register and obtain the club badge. The president is Professor A. J. Cook, Agricultural College, Mich.; secretary, F. M. Webster, Lafayette, Ind. Members of the club intending to contribute papers will send titles to the secretary. The Botanical Club will hold a meeting, as usual, on Thursday, Aug. 21, at the State House. Communications should be sent to the president, Dr. N. L. Britton, Columbia College, New York, or to the secretary, Dr. Charles R. Barnes, University of Wisconsin, Madison, Wis. The Society for the Promotion of Agricultural Science will hold its eleventh annual meeting in Indianapolis, beginning on Monday evening, Aug. 18, in the room assigned to Section I in the State House, and continuing on Tuesday. For further information address Professor W. R. Lazenby, secretary, Ohio State University, Columbus, O. The

American Geological Society will hold its semi-annual meeting at the State House in Indianapolis on Aug. 19. Professor J. D. Dana, New Haven, Conn., is the president, and Professor J. J. Stevenson, University of the City of New York, secretary. Members of the association arriving in Indianapolis before the meeting should call for information at the temporary office of the local secretary, No. 19½ North Pennsylvania Street. A few days before the meeting a local office of information will be established near the railroad-station, as will be stated in the circular of the local committee.

— Professor Arthur Winslow, State geologist of Missouri, in submitting to Gov. Francis a statement setting forth the operations of the State Geological Survey during the month of June, says that during the early portion of the month the results of detailed field-work in the coal-fields were reduced, and transferred to the final map. Since this time field-work has been continued, and about twenty square miles have been covered. Paleontologic work has been continued in Pettis County, and has been extended into Lafayette County as far as Odessa. Several hundred pounds of specimens have been collected, and have been shipped to Professor Williams for study. On June 20 Mr. Erasmus Haworth reported for work, and has been assigned to the south-eastern part of the State, where he is engaged in defining the distribution and relations of the crystalline rocks of that section. Mr. Haworth is professor of geology and mineralogy at Penn College, Oskaloosa, Io. He has worked in the south-eastern portion of the State in past years, and has volunteered his services to the survey during the present summer. In the laboratory the analytical work on the mineral waters collected in April is completed, as well as the calculation of results, and the preparatory notes for a report on the results have been written out. In addition, analyses have been made of forty-seven specimens of limestone from quarries in and about St. Louis, with the object, among others, of determining their qualities for building-purposes, and for the production of lime and cement. Inspections have been made in Cape Girardeau and Stoddard Counties. In Cape Girardeau County clay deposits of promising appearance were visited. The qualities of the clay and the distribution of the deposits deserve determination. In Stoddard County a deposit of brown coal or lignite was visited, near Ardecla, on the Cotton Belt Railway. This coal has been opened up during the past winter by shafts and drifts. It occurs associated with the clays and sands of Crowley's Ridge. Similar coal is found along the same ridge farther south, in Arkansas.

—The latest plan for connecting a moving tram-car to an underground conductor without a slot in the roadway is that of the Lineff Electric Traction and Lighting Syndicate, of 11 Queen Victoria Street, London. According to *Engineering*, the track consists of the usual grooved rails, and a third or contact rail between the others. This is flat-topped, and the surface lies flush with the roadway. It is formed in short lengths, about three feet, separated from each other by about half an inch of asphalt. These short rails are electrically insulated from each other, and the current is directed into each of them in succession as the car passes over them. This, as is well understood, is to prevent the excessive leakage that would take place if a long length of rail were in connection with a wet roadway, and also to prevent other vehicles making a short circuit between the contact rail and the return-current rail. The connection of the short rails with the copper conductor is made by a magnet on the car acting on a contact-maker under the rail, one end of this contact-maker being joined to the conductor. On the under side of the car is a very powerful electro-magnet about one and a half times the length of a rail. At each end it has a pole-piece, consisting of a roller running on the rail, and two blocks just clearing the rail. This magnet is energized by the main current, and consumes one hundred and twenty to one hundred and fifty watts, although sixty are said to be sufficient for the purpose, under favorable circumstances. The rail, which is five or six inches deep, stands on a longitudinal earthenware sleeper; and the whole is solidly embedded in a mass of asphalt, which extends below the sleeper. In a groove in the sleeper runs the conductor, and in a second groove is laid a strip of galvanized hoop iron. This strip is connected at one end to the conductor, and the other end is free. When the magnet passes over it, the rail attracts the iron, which rises, and makes contact with it. The current then flows from the conductor through the strip to the rail, and thence by a bush to the motor on the car. Neither the strip nor the rail has any special contact surfaces. They are both galvanized, and there is no other means provided to insure good connection. As soon as the magnet has passed, the rail ceases to be magnetic, the strip falls back, and that particular rail is again insulated, its office being taken by the one in front of it; and so on. The principal feature of novelty lies in the use of a second, or so-called "hidden rail," placed alongside the contact rail underground, and, like it, embedded in the asphalt. This is also in short lengths, but it is disposed so as to break joint with the first rail, and thus reduce the resistance of the magnetic circuit. It is stated that by the use of this second rail a very much less powerful magnet is able to move the contacts. The inventor seems to have aimed at cheapness of construction; and it is feared that difficulties will arise in practice from the crudeness of some of his arrangements, although a short experimental line in the yard of the West Metropolitan Tramway Company, Chiswick High-Road, works very well.

—Miss C. W. Bruce offers the sum of six thousand dollars during the present year in aiding astronomical research. No restriction will be made likely to limit the usefulness of this gift. In the hope of making it of the greatest benefit to science, the entire sum will be divided, and in general the amount devoted to a single object will not exceed five hundred dollars. Precedence will be given to institutions and individuals whose work is already known through their publications, also to those cases which cannot otherwise be provided for, or where additional sums can be secured if a part of the cost is furnished. Applications are invited from astronomers of all countries, and should be made to Professor Edward C. Pickering, Harvard College Observatory, Cambridge, Mass., before Oct. 1, 1890, giving complete information regarding the desired objects. Applications not acted on favorably will be regarded as confidential. The unrestricted character of this gift should insure many important results to science, if judiciously expended. In that case it is hoped that others will be encouraged to follow this example, and that eventually it may lead to securing the needed means for any astronomer who could so use it as to make a real advance in astronomical science.

—The increasing importation of foreign meat to England has resulted in the invention of a number of refrigerating appliances, among them Hill's patent system of dry-air refrigerating apparatus, which is on view at the working dairy at the Royal Military Exhibition, Chelsea, Eng., and at the offices of the company, 114 Cannon Street, London. The distinctive feature is that no machinery is in use, the cold air being produced from the distillation of ammonia gas, a principle which is not by any means new. The apparatus consists of steam-generator, ammonia boiler, separator, and condenser for producing cold, and a refrigerator or cold chamber. This chamber, as described in *Engineering*, is constructed in most cases of a double casing of wood, lined with charcoal as a non-conductor; and the roof is formed by a tank containing a bath of chloride of calcium liquor in sufficient quantity to store up the cold as produced. In the case of the apparatus exhibited on Cannon Street on Wednesday, June 25, the chamber was seven feet by nine feet by seven feet high, and the ammonia boiler two feet diameter by ten feet long. The solution of ammonia in the boiler is heated by steam from any boiler, or from a specially constructed slow-combustion stove, with a spiral coil giving large heating surface. Alongside it is placed a water separator for drying the steam, which passes to a boiler three-fourths filled with a solution of ammonia. To this the steam entering by several pipes imparts heat, driving the ammonia into the form of gas. Above the boiler is placed a separator for taking off water carried forward in the distillation of the ammoniacal gas. The water thus separated passes by gravitation to the boiler. Alongside it is a corresponding cylindrical vessel into which the dried ammoniacal gas passes, and there it is condensed by its own accumulation of pressure, and the latent heat carried off by the

circulation of cooling water. This liquid anhydrous ammonia flows into the refrigerators suspended in the tank forming the roof of the cooling-chamber. The pressure is then rapidly reduced by opening a communication with a separate chamber, and the sudden evaporation of the liquid anhydrous ammonia takes place at the expense of the sensible heat in the cold-storage bath in the tank, which therefore becomes very cold, and draws heat from the chamber in which the meat is stored. The bottom of the tank is corrugated, which gives a large increase in the cooling area; and to the lower angles of the corrugation, gutters are suspended, carrying off the water, so that the atmosphere is dried as well as cooled. On June 25, the temperature, after the doors of the chamber were closed, was reduced in a comparatively short time by about 40° to 39°. It was tested from the evening of June 14 to the morning of the 20th, and it is said that the temperature of the liquid in the tank rose in that time from 16½° to 31°; the fall of temperature in the chamber being from 52° to 36¾°, while in the office in which the chamber was placed the fall was from 65° to 61°.

—Among the papers read at the closing meeting of the Royal Society, London, was one by Professor Ewing of the Dundee College, entitled "Contributions to the Molecular Theory of Induced Magnetism," in which experiments of a novel and curious kind were described, leading to an important conclusion. Professor Ewing has examined experimentally Weber's theory of molecular magnets, according to which the molecules of iron are always magnets, which point anyhow in an unmagnetized piece, but are turned round to point one way when the iron is magnetized. It is well known that in the development of this theory by Maxwell and others there has been much difficulty in reconciling the results of the theory with what is known about the magnetic quality of iron and steel, and many arbitrary assumptions have been suggested in order to make the theory fit the facts. Professor Ewing's experiments have removed this difficulty, showing that no arbitrary assumptions are necessary, and that the known character of the magnetizing process may be deduced from the molecular theory in its simplest form. The experiments, as described in *Nature*, were made by means of a model in which a large number of small pivoted permanent magnets are grouped to represent the molecular structure of iron. When a magnetic field is applied, the action of the small magnets on one another makes them behave in a way that exactly agrees with the observed behavior of a bar of solid iron when it is magnetized. The model exhibits all the variations of susceptibility which are known to take place, and explains how magnetic hysteresis occurs without any thing like friction among the molecules.

—An exceptionally pretty and instructive series of new experiments upon the action of carbon heated to whiteness in the electric arc on various gaseous compounds is described in a late number of the *Berichte* by Professor Lepsius of Frankfurt, according to *Nature* of July 3. Perhaps the most important are a group of four experiments illustrating the relative combining powers of the four elements, iodine, sulphur, phosphorus, and carbon. The apparatus employed consists of a specially modified Hofmann eudiometer, one limb of which is 40 millimetres in diameter and 300 millimetres long, and the other longer limb narrower, and furnished with a mercury reservoir at its upper end. The wider limb, which is the re-action tube, is furnished with a stopcock at the top, and just below this are two tubuli through which the adjustable carbon poles are inserted. At the base of the wider limb a second stop cock is placed so as to permit of the adjustment of the mercury. The gas to be experimented upon is introduced into the apparatus at the upper stop-cock by allowing mercury to run out at the base. Four such eudiometers are arranged in a row, and 100 cubic centimetres of gas introduced into each. Into the first, hydriodic acid is introduced; into the second, sulphuretted hydrogen; into the third, phosphuretted hydrogen; and into the fourth, marsh-gas. The gases thus stand at the same level in each of the four re-action tubes. The current from a battery whose electro-motive force should amount to 60 to 80 volts is then allowed to pass between the carbon poles, which are, of course, in contact at first, and then gradually drawn away until the maximum arc is obtained. Each re-action may be performed separately, or all four may be allowed to proceed simultaneously by adopting an arrangement in multiple arc. In hydriodic acid the brilliant arc-light is tinted a magnificent purple, and the whole space above the mercury becomes filled with violet vapor of iodine. Notwithstanding the considerable heating effect of the discharge, the volume of gas perceptibly diminishes, the liberated iodine rapidly depositing in minute crystals upon the walls of the tube. So rapid, indeed, is the diminution in volume, that mercury requires to be poured into the reservoir to prevent the entrance of air into the re-action tube. In a very few minutes the re-action is complete, and the mercury ceases to rise. In sulphuretted hydrogen the light is colored blue, and copious clouds of suphur are produced, which settle upon the walls in the form of a white transparent coating. The volume of gas is considerably augmented, owing to the expansion by heat, and the re-action is likewise completed in a very brief space of time. In phosphuretted hydrogen the arc glows with a dazzling red light, the volume visibly augments at a rapid rate, and red clouds of phosphorus are thrown off, the glass walls being covered with red phosphorus, among which are to be found notable quantities of the ordinary yellow variety. The mercury attains its maximum height in the narrow limb in a minute, at most, from the moment of switching on the current. In the case of marsh gas, the whiteness of the arc appears at first to be rendered more intense, and is surrounded by dense black clouds of carbon, which form a striking background. The upper part of the vessel, however, soon becomes covered with an opaque deposit which perceptibly diminishes the brilliancy of the light. The volume appears to increase by leaps and bounds, and in a few seconds attains its maximum. At the end of the experiment, after cooling, the volume of hydrogen left in the first case is 50 cubic centimetres; in the second, 100; in the third, 150; and in the fourth case, 200; thus showing in a most striking manner that an atom of iodine combines with one atom of hydrogen, sulphur with two, phosphorus with three, and carbon with four, atoms of hydrogen.

—According to *Nature* of July 3, the third summer meeting of university extension and other students will be held at Oxford in August next. The meeting will be divided into two parts. The first part of the meeting will begin with an inaugural address by Professor Max Müller at 8.30 P.M. on Friday, Aug. 1, and will end on Tuesday evening, Aug. 12. The second part of the meeting will begin on Wednesday morning, Aug. 13, and end on Tuesday evening, Sept. 2. This period will be devoted to quiet study. The courses of lectures will be longer than those delivered during the first part of the meeting, and will deal in greater detail with the subjects then introduced.

—The clove-tree was introduced into Zanzibar about the year 1830, and its cultivation now forms the chief industry of the islands of Zanzibar and Pemba. The chief supply of cloves is obtained from these islands. Consul Pratt, who has lately written a report on the clove-culture of Zanzibar, says that a ten-year-old plantation should produce an average of twenty pounds of cloves to a tree. Trees of twenty years frequently produce upwards of one hundred pounds each. Mr. Pratt reports that the yield of the present season will probably exceed that of any previous season, and amount to thirteen million pounds, averaging a local value of ten cents per pound.

—A pneumatic dynamite gun built for the British Government was tested at Cold Spring, N.Y., on July 8, in the presence of several military and naval officers. As the test was merely to determine the range and capabilities of the gun, and not the destructiveness of the projectiles, the latter were filled with sand instead of an explosive. Four shots were fired, two of which were failures, the thin brass shells of the projectiles bursting in mid-air, owing perhaps to defective packing of the sand. The other shots were successful; the projectiles, weighing 520 pounds each, attaining a range of 4,008 and 4,680 yards respectively, the contract only requiring a range of 3,500 yards. The gun, or shooting-engine as it may be called, is fifty feet long, and weighs much less than four tons. It is a modification of those with which the dynamite cruiser "Vesuvius" is armed.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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NEWS FROM CLARK UNIVERSITY.

A ONE-YEAR'S course in the history and principles of education will begin in October next at Clark University, and continue till June, 1891. This course will be given by the president of the university, Dr. G. Stanley Hall, and by Dr. William H. Burnham, docent in education, and will be divided as follows: I. General history of educational ideas and institutions in antiquity. II. General history of educational ideas and institutions during the middle ages and down to the early decades of the present century. III. Contemporary educational institutions. A good part of the year will be spent in this field, which will be treated as follows: The educational system of Germany will first be considered, and each class of institution from the kindergarten to the university will be described, including legislation, administration, financial methods, supervision, buildings, curricula, training, testing and examination of teachers, methods of instruction in the leading subjects, educational literature, brief biographies, etc.; French educational institutions will then be described in the same way; and then will follow Italian, Scandinavian, Russian, British, and American educational institutions. While the presentation of the systems will necessarily be more or less historical, the chief object will be to describe these systems as they exist to-day. While considering elementary work and grades, much stress will be given to intermediate and higher education, including such topics as the constitution of universities, with historical sketches and descriptions of typical institutions, both European and American; the relations of government to science in the various countries; learned societies, associations, and academies; professional and technical instruction; examinations; etc. IV. Philosophical conclusions and practical applications of this survey; general views concerning the end, direction, and methods of education, with reference to the needs and problems of our own country.

In preparation for these courses, Dr. Burnham, a Harvard graduate, who gave his chief attention to philosophical courses, taught successfully in a normal school, and studied psychology and education three years in Baltimore, taking the degree of doctor of philosophy there in 1888, was some time since sent to Europe by Clark University, to study special problems and institutions in several European countries. Dr. Hall, who represented this department at the Johns Hopkins University, spent last year in visiting educational institutions and collecting literature and other material for this course in every country in Europe except Portugal. A carefully chosen collection of educational literature covering the topics of this course will be placed at the disposal of students, and their reading will be individually directed in it. The methods will consist of lectures, general and individual conferences, special lines of reading, etc. Certificates of attendance will be given to those who follow the entire course, and certificates of proficiency to those who desire to pass an examination at the end of the year. Should the attendance warrant it, and should it be desired, pedagogical excursions may be conducted to institutions in Worcester and other neighboring cities. In addition to these strictly educational courses, the philosophical and psychological courses may, by special arrangement, be attended by students of education. This course is intended for those who desire to qualify themselves for professors of education in colleges or normal schools, and for superintendents, principals, and others who desire to make a specialty of education. For further information address the clerk of the university, Worcester, Mass.

PRESENT CONDITION OF SILK-CULTURE IN FRANCE.

WITH reference to the recent demand of certain delegates representing the agricultural, and especially the silk-growing, industry of southern France for a protective duty upon imported cocoons and raw silks, with certain restrictions upon silk-manufacturers in respect to "loading" their goods in the process of dyeing, the United States consul at Marseilles gives a sketch of the history and present condition of this branch of French industry.

The cultivation of the mulberry-tree for the rearing of silk-worms began in the south of France early in the seventeenth century, but it was not until a hundred and fifty years later that the industry became important or largely profitable. By the year 1780 the annual product of cocoons had risen to 6,600,000 kilograms, which were then worth about 2s. a kilogram. This was a lucrative result in those frugal times; and the business continued to flourish until 1853, when the crop reached 26,000,000 kilograms at about 3s. 9d. the kilogram, thus adding a sum of about £4,700,000 to the wealth of the rural classes. The country was admirably adapted to the growth of the mulberry-leaf; the warm, dry climate of Provence and Comtat Venaissin was favorable for the worm; the labor of raising the cocoons and reeling them could be performed by women, aided to some extent by children and aged people, thus entailing scarcely any increase in the expenses of the farm; and the permanent prosperity of the industry seemed for a time assured.

Then a series of disasters began. The peasants, in their eagerness to raise every possible silk-worm, had for years overstocked their premises, and in the crowded, ill-ventilated, and often dirty and neglected *magnaneries* the worms degenerated from year to year until they became a prey to several new and destructive diseases. The most serious of these were the *muscadine,* which was thought to have been imported with silk-worm eggs from Turkey; and the *pebrine,* a malignant cryptogamous infection, generated by the conditions above cited, and which is commonly cited in France as *la maladie.* The *muscadine* caused a loss of £800,000 in a single season. In thousands of cases every silk-worm in a farmhouse or breeding-establishment perished; and this disease

was succeeded by the *pebrine*, which swept the silk-growing district irresistibly, until a discovery was made which provided a practical escape from its ravages. This discovery was a new and certain method of detecting the disease in the chrysalis, or moth, which lays the eggs that serve as the seed for next year's growth of silk-worms. By the time, however (1880–81), that this remedy was generally known and practised, the situation had become in other respects almost hopeless. After the war of 1871, wages and the cost of living had greatly increased. Selling prices for farm produce of all kinds, which had formerly been ample, were no longer sufficient, in many cases, to pay the cost of production. The price of cocoons, which at one time had been as high as eight francs a kilogram, fell to six, and then to four francs, and even less. Discouraged by disease and low prices, thousands of farmers rooted up their mulberry-trees for fire-wood, and devoted the ground to vines and other forms of culture. The skilled women, who had formerly gathered the leaves for the silk-worms, and reeled the cocoons, had gone to other employments at higher wages than the languishing silk-industry could afford to pay. By this time French manufacturers no longer depended upon home-grown silk.

During recent years important discoveries in the chemistry of silk-manufacture had enabled the spinners, by skilful dyeing and "loading" their goods with gums and mordants, to use inferior grades of Japanese, Chinese, and Italian fibre in place of the superior organzines which had given the fabrics of Lyons and the ribbons of St. Etienne their lustre and renown. It is urged that the manufacturers were protected by high import duties; but the raw material which fed their looms was, and still remains, duty free. It is said that the weighting and loading of French silks have been carried to an extent which has injured their reputation, and not only disgusted French consumers of such goods, but raised the question whether the use of so much low-grade Asiatic fibre has been, after all, a blessing to the manufacturers of France.

There is now a new and steady demand for better material, and the question has now arisen, "Why not protect the native silk-growers, and raise it at home?" It is argued that it is solely due to the competition of foreign cocoons, and the increasing use of low qualities of silk loaded with fraudulent dyes, that French silk culture has languished since Pasteur's discovery conquered the malady which had threatened its existence. The peasants of France, who hatched more than a million ounces of silk-worm eggs in 1872, used less than a quarter of that quantity in 1886.

In conclusion, Consul Mason says, "The government, which had increased the duties on wheat and cattle, left the agriculturists without protection, and, seeing no hope of relief, many have given up the struggle, and either emigrated to South America, or flocked to the already overcrowded cities and towns. There are, in this consular district, six rural departments in which the population is steadily decreasing, and this decadence of agricultural prosperity involves a serious menace to France."

HEALTH MATTERS.

Oxygen-Gas in Pneumonia.

IN an article on the value of oxygen-gas in pneumonia, in the *Lancet*, May 24, 1890, Dr. John Chambers says that during the early months of last year, as a practising physician in the United States, he met with many cases of the disease, occurring chiefly in adults and men of middle age. These symptoms in the cases observed were due directly to the deficient aeration of the blood. They were marked by difficulty of breathing, together with weakness of the heart's action. The faulty aeration is recognized almost at its onset by the livid hue of the lips, of the ears, and the finger-nails. This condition is well known to every physician, and, as it is the token of immediate danger to the patient, it is important that the best measures be taken to overcome, if possible, the difficulty. In pneumonic cases in young and old, presenting symptoms of deficient blood aeration, the inhalation of oxygen-gas has, in Dr. Chambers's hands, proved to be a remedy of remarkable power. Under its use, the lips recover their redness, the breathing becomes easy, and the toneless heart is strengthened in its action.

As to the method of using the gas, a few words may be added. A supply of pure oxygen-gas can be easily obtained from the laboratory of a chemist. It is collected in a receiver, and can be conveyed a considerable distance without loss of gas. In the immediate use it is better to fill a rubber bag from the tank than to give the gas directly to the patient. The rubber bag should have a capacity of one or two gallons, and be provided with a stop-cock at one end. To this a short rubber tube ending in a mouth-piece can be readily attached. The mouth-piece is applied over the mouth of the patient, the valve of the bag is turned, and the whole or any portion of the gas in the bag can be inhaled at a single dose. As the gas is heavier than air, its escape from the bag will be facilitated by holding this above the level of the mouth, and slight pressure upon the bag will still further assist in the inhalation. From half a gallon to a gallon of gas can be given every half-hour with perfect safety, and with great relief to the sufferer's symptoms. Such doses have been continued for four days and nights, with the most satisfactory results. Life has certainly been saved in many cases when it has seemed that death was inevitable. When cardiac weakness is urgent, an excellent and safe tonic is found in sulphate of strychnia, which may be given in doses of one-eightieth of a grain every four or six hours, until a decided change in the condition of the pulse is manifest. When this occurs, the strychnia is omitted, but may be of use again in a day or two if the pulse should fail. The relief in desperate cases, where asphyxia is threatened, is so marked that it is astonishing physicians have not more generally used this simple remedy. The use of oxygen-gas imposes a great deal of labor on physicians and nurses. With a little training, however, the nurse soon learns to give the oxygen, thereby relieving the physician. Two nurses should be employed,—one for the day, and one for the night.

An Epidemic of Pulmonary Phthisis.

Dr. Marfan, chief of the medical clinic of the Faculty of Medicine of Paris, gives, in the *Semaine Médicale*, Oct. 23, 1889, the details of a localized epidemic. In an important business-house in the centre of Paris, twenty-two persons were employed about eight hours a day. One of them, aged forty, employed at this place for twenty-four years, had been phthisical for three years, when he died on the 6th of January, 1878. He coughed and spat upon the floor for three years, and did not leave his work till three months before his death. From that time, out of twenty-two persons employed, fifteen have died. One only died of cancer: the remaining fourteen died of pulmonary tuberculosis. One year before the death of the first person, who appears to have been the starting-point of the epidemic, two employees, who had been connected with the same business for more than ten years, began to cough and spit upon the floor. They died in 1885. Beginning with the end of 1884, the deaths followed each other at closer intervals.

Dr. Marfan states the unsanitary conditions of the apartment in which these persons were employed. It was small, and the cubic air-space was less than ten cubic metres (350 feet) to each person. It was badly ventilated, badly lighted, and the gas was burned a part of each day, especially in winter. The floor was of wood, uneven, cracked, and very dirty. The first victim of phthisis, and those who followed, spat directly on the ground; and the sputa, becoming dry, was converted in this already unhealthy apartment into a poisonous dust. The room was swept each morning; and sometimes the employees arrived before the sweeping was finished, and while the dust was still floating in the air. It was difficult to sweep the room thoroughly, since the tables were fixed to the floor. It appears very probable that the swallowing and inhaling of this tuberculous dust was an essential factor in the propagation of the disease.

The proprietors of the place where the deaths occurred removed and burned the floor, and so rapidly was the work accomplished that the reporter had no time to collect a sample of the dust from the cracks in the floor for the purpose of experiments upon animals. A new floor was laid, which was waxed and treated from

time to time with spirits of turpentine, all painted surfaces were repainted, and Dr. Marfan recommended that the floor should be swept in the evening after the departure of the employees, and that the windows should be left open all night.

Dr. Vallin recommends in place of these measures a mixture of equal parts of coal-tar and spirits of turpentine, or of paraffine dissolved in warm petroleum, and, in place of the sweeping, the removal of the dust by sponges, or cloths moistened with an antiseptic solution.

Tissue Metabolism in Cancer.

Dr. F. Müller has made some careful comparative observations upon the urine in cases of cancer and other wasting diseases, and in simple starvation. He finds, according to the London *Lancet*, that in the cancerous the excretion of nitrogen far exceeds the amount ingested, and infers that this excess must in consequence be derived from the disintegration of the albuminoids of the body. However, in two out of seven cases this loss was not greater than occurred in other individuals similarly insufficiently nourished. The chlorides were, on the other hand, notably diminished,—a fact, he thinks, pointing to the source of the excreted nitrogen; viz., from the organ albumen, and not from the circulating albumen. Obviously, however, many diseases share, with carcinoma, in this disintegrating process, as Müller showed to be the case in chronic febrile affections, especially severe forms of malaria, in leukæmia, and pernicious anæmia. Previous observers do not coincide in their statements on this head as regards leukæmia. Voit and Pettenkofer found no marked evidence of increased metabolism in this affection, and Fleischer and Penzoldt concurred in this so far as regards mild cases. But in severe cases the last-named find the urea to be increased both absolutely and relatively. Sticker and Klemperer arrived at the same conclusion. Respecting pernicious anæmia, there is a concurrence of testimony in support of increased nitrogenous excretion. Reverting to cancer, this evidence, Müller thinks, goes to prove that malignant disease excites the formation of metabolic products which are poisonous to the organism. He points out that cachexia develops in the cases of malignant growths, no matter how limited, and without their involving any important organ; whereas a non-malignant tumor may attain great dimensions without affecting the excretion of urea. At the same time no such poison or ferment destructive of albumen can be isolated from cancerous tumors, although the fact pointed out by Feltz, that the urine of the cancerous is more toxic to animals than that of healthy individuals, is, with other facts, highly suggestive of that view.

Kola-Nut for Seasickness.

Dr. C. W. Hamilton of the British Navy writes to the *British Medical Journal* of May 10, 1890, that he has found the seed of the kola (*Sterculia acuminata*) a most successful remedy in seasickness. From half to one dram of the seed was slowly chewed, and in about half an hour the distressing symptoms of the malady gradually disappeared. The writer had never found any drug to act as well as this, and believes that further trials will prove it to be an effectual remedy for seasickness.

ELECTRICAL SCIENCE.

Electric Welding and Ice-Machines.

THE ice-famine is proving a bonanza for the Thomson Electric Welding Company, says the *Boston Advertiser*. There is a great demand at present for pipe-welding machines, with which to make the long coils of pipe for artificial-ice machines, for brewery coils, for sugar-refinery and general refrigerating purposes. The pipes originally come in lengths of from eighteen to twenty feet. The coils are frequently six hundred to seven hundred feet long. By old systems the pipe is welded together by a slow and laborious process, requiring fifteen minutes for each weld, two blacksmiths and a dozen helpers, and a large space, each pipe being lifted from the forge to the anvil, and a mandril inserted. There is often a serious loss of ammonia as a consequence of imperfect welding. By the electric process the welds can be made so homogeneous that there is no chance for ammonia to escape. The length of time required is two minutes for each weld, and all the help required is a man and a boy. The cost of the old process is fifteen cents each; by the new, two cents. As the coil is bent after each weld, the work can be done in a very small space. The managers of the Welding Company consider this, next to shell-welding, the most important industry which has sprung up as a result of the welding invention.

Atmospheric Electricity in the Tropics.

In order to investigate the relations of atmospheric electricity to the moisture of the air within certain limits, Herr F. Exner has made observations of the fall of atmospheric potential in countries with high relative moisture, particularly in the Indian Ocean between Aden and Bombay, in Bombay itself, and in Ceylon, both on the coast and in the interior. According to *The Electrical Engineer* of July 9, the measurements were made with transportable apparatus invented by Herr Exner. All the values of the fall of potential were positive. Near the coast the finely divided spray arising from the breaking of the waves exerted an increased action on the fall of potential. On the other hand, measurements made in Cairo and the vicinity showed that there the dust of the air exerted a lessening influence on the fall of potential, which, with a strong wind, was so marked that the sign of the fall of potential became negative.

Storms and Electric Wires.

It has for some years been the practice at the Berlin post-office, says the London *Electrical Review*, for the employees to make a note of storms and magnetic disturbances, direction of storms, length, etc.; and the result has demonstrated that underground wires, without being entirely free from the influence of magnetic storms, are much less liable to disturbance than overhead ones, and, on the other hand, that accidents from lightning are much less serious in those towns where the overhead system is in vogue.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

A Stony Meteorite from Washington County, Kan.

HAVING seen press despatches from Washington, the county seat of Washington County, Kan., announcing the fall of an aerolite near that town on Wednesday, June 25, I visited that county at the earliest possible opportunity, for the purpose of ascertaining the facts. I found them to be as follows, and verified by a multitude of witnesses: At about ten minutes before one o'clock on the afternoon of June 25, the sky being free from clouds, a strange noise was heard by thousands of people residing in the counties of Washington, Republic, Cloud, Clay, Riley, Pottawatomie, and Marshall, in Kansas, and in the counties of Thayer, Jefferson, and Gage, in Nebraska. The same noise was heard by hundreds of people in counties more distant than those mentioned.

The descriptions given me of the character of this strange sound were exceedingly various. Mr. E. F. Woodruff of Clifton, fully twenty-five miles from the place where the meteor struck the ground, stated to me, that while standing on the front porch of his hotel after dinner, a few minutes before one o'clock, his attention was attracted by a rumbling sound like thunder, which began gently, and increased in power to a maximum, rising even above the din of a Missouri Pacific Railroad train which passed within a few rods during the continuance of the phenomenon. The sound appeared to him to come from the zenith, and to continue for two or three minutes, gradually fading away, and being at no time of an explosive character.

Mr. John Yates of Grant Township, more than fifty miles from Washington, on the contrary, heard the sound of the flying me-

teor, and described it as like the report of a hundred-pound cannon, which shook his house, and jarred the windows. He at first supposed the disturbance to be produced by the explosion of a boiler at Gann's elevator, in the neighboring town of Riley. Mr. Sprengle, father of L. J. Sprengle of the *Washington Republican*, not only heard the meteor, but looking toward the zenith, shading his eyes from the glare of the sun, saw just below that luminary a swiftly moving mass of waving mist, followed by a double trail of bluish smoke.

This aerolite was seen by many observers at a much greater distance from the place where it fell. Mr. D. C. Ruth of Halstead, Harvey County, Kan.(a hundred and thirty miles distant in a direction slightly west of south), saw a large fire-ball moving through the atmosphere at a few minutes before one o'clock on June 25. It was also seen at Topeka (eighty-seven miles south-east) by a neighbor of H. R. Hilton, Esq. It was reported by the newspapers as having been both heard and seen at Atchison (a hundred and two miles distant) and at Leavenworth (a hundred and fifteen miles distant), the last two places being in a direction east-south-east from Washington A note received from C. W. Marston, Esq , of Cedar Junction (a hundred and thirty miles south-east from Washington) makes the following statements: "An aerolite passed in sight of this place on Wednesday, June 25, at about 1 P.M. Of the several who saw it, Mrs. John D. Randall says of it, 'It was a ball of fire as large as a table. It had a trail like a comet, and it wabbled like a kite.' "

At Beatrice, in Nebraska, forty miles north-east of Washington, it was reported as a brilliant meteor passing over the city from north to south, leaving a distinct fiery trail behind. The fact that at places to the north of the point of collision with the earth the meteor appeared to be moving toward the south, while at places to the south it appeared to be moving toward the north, corroborates the testimony given by the nearly perpendicular sides of the hole it made in the ground, that it passed through the atmosphere from the vicinity of the zenith.

The meteor reached the ground, and buried itself out of sight, four feet deep, below the eighteen inches of upper alluvium in the underlying shaly clay or "gumbo." This spot is located three miles and a half north of Washington, in Farmington Township, about a hundred yards from the north and south road, near the south-west corner of the north-west quarter of the south-west quarter of Section 13, Township 2, Range 3, east of the sixth principal meridian. The farm belongs to Mrs. Lydia V. Kelsey of Iowa, and was rented by Mr. J. H. January, who was on that day breaking the prairie sod. The noon hour had not quite expired, and Mr. January was underneath his wagon making some repairs, when he heard the sound of the approaching meteor, and came out to ascertain the cause of the disturbance. He had hardly gained the erect position, when the meteor struck the ground only a few rods distant, throwing up the earth to a height of forty feet into the air, and outwards for about twenty-five feet. It was also seen to strike the earth by Miss Guild, a teacher, who was returning to her home in the country after her forenoon's attendance at the Washington County Normal Institute, and was at the instant driving her horse and cart along the north and south road, only a hundred yards distant. As soon as her frightened and trembling horse had recovered from the shock, Miss Guild drove to the spot, which she reached at the same moment with Mr. January. As soon as Mr. January had calmed his frightened horses, he began to dig for the aerolite; and with the help of a neighbor, Mr. J. D. Foster, and three other men, he reached the upper surface of the stone in one hour, but it required three hours to remove the mass from its bed, it was so firmly held in place by the compressed "gumbo." The stone was not hot when reached, which may be explained by the fact that it seems to have passed through the minimum amount of air from a direction but a few degrees south of the zenith. It was covered, however, by the usual burned crust. The stone was found to have been cracked, doubtless by the force of collision acting upon a body already under the disrupting strain of unequal temperatures. The entire mass weighed a hundred and eighty-eight pounds, and was divided by this crack into two portions, weighing respectively a hundred and forty-four and forty-four pounds. The smaller mass was soon subjected to a process of sledge-hammering by the hundreds of people who almost immediately visited the spot. Nearly every citizen of Washington has in his pocket a small fragment of the stone. The portion remaining, weighing a hundred and forty-four pounds, is somewhat wedge-shaped, in dimensions nineteen by seventeen inches, by eight inches at the base. The writer obtained from Mr. J. D. Foster for analysis a fragment weighing two pounds and a quarter. In color the stone is dark slate, resembling a compact trap-rock. An analysis has been made by Mr. E. E. Slosson, assistant in our chemical department, whose preliminary report is as follows:—

"The stone is of a gray color, and in texture resembles porphyry. A few metallic grains are all that can be distinguished with the naked eye. Under a microscope by chemical treatment the following minerals can be detected:

"1. A white crystalline silicate, insoluble, forming about half the mass of the whole; probably enstatite or a similar bisilicate of the pyroxene group.

"2. A black translucent crystalline silicate intermingled with the above, though less in amount. It is decomposed by *aqua regia*, and contains iron; probably a uni-silicate of the olivine type. These two minerals are in some fragments arranged in alternate microscopic layers of equal thickness.

"3. Malleable nickeliferous iron in small irregular masses, intimately mixed with troilite and the silicates.

"4. Troilite or pyrrhotite in microscopic particles disseminated through the whole rock, estimated from sulphur to be about 10 per cent.

"5. Chromite, distinguishable as small black magnetic crystals in the residue after treatment with the acids.

"6. A few scattered silicious crystals, yellow and red; too small to determine, probably olivine.

"The following is an approximate analysis of a small fragment: metallic iron (with part of the iron in silicates), 14.953 per cent; troilite, 10; soluble silicates (olivine), 25.147; insoluble silicates (enstatite), 49.9; nickel and chromite, undetermined; specific gravity of fragment weighing two pounds and a half, 3.48, water at 25° C."

The hundred and forty-four pound mass has been bought by the writer and Professor F. W. Cragin of Washburn College, Topeka, in equal partnership, for the benefit of the museums of their respective institutions. F. H. SNOW.

University of Kansas, Lawrence, Kan., July 7.

Another Meteorite from Kiowa County, Kan.

SINCE my communication in *Science* of May 9, in reference to the Kiowa County (Kansas) meteorites, I have again visited the locality, and obtained a 218½-pound pallasite. This is not a new "find," but is one which was first discovered upon the farm of Mr. James Evans more than a year ago. The location may be seen by consulting the map illustrating Mr. Kunz's article in *Science* of June 13. Only about one square foot of the surface of this meteorite, just level with the ground, was exposed to view, and it thus easily escaped subsequent observation on the unploughed, grassy prairie. The dimensions are 20½ by 16½ inches, by 10½ inches at base. The shape is that of an irregular triangular pyramid, and it stands easily upon its base. The specimen, not having been exposed to the weather and the dangers of rough usage, as were the other members of this group, presents fine clusters of olivine crystals in several cavities upon two of its faces. There are eight cavities on one face. Some of the cavities are four inches in diameter and two inches deep. Nearly all the cavities contain fine crystals of yellow olivine and of chromite. Some of the former are $\frac{3}{8}$ of an inch in diameter, and so perfect that the angles can readily be measured. This specimen is also unique in that the crystals of chromite are so large and so prominent. The chromite has a fine lustre, gives a dark-brown powder, and scratches glass.

Much of the olivine is black and glassy, with a conchoidal fracture. It shades imperceptibly into the honey-yellow and colorless varieties. The light variety yields a light-brown powder, and is very brittle. Its fusibility is about five.

At some points on the surface there is a dirty white incrustation. This, on examination, proved to be carbonate of lime, and is without doubt due to the deposits from the calcareous soil in which the meteorite was embedded.

The prevailing color of this iron is dark reddish brown, more inclined to red than others of this fall that we have seen.

On cutting a section from the meteorite, and treating the polished surface with nitric acid, the characteristic Wiedmannstaaten markings are visible. The fragments of troilite can be plainly seen on the polished surface. The meteorite has about the same arrangement of iron, olivine, etc., as others of this group. Its specific gravity, as obtained from the whole mass, is 4.79; that of the iron and nickel alloy is 7.70; of the olivine (yellow), 3.64 (water at 25° C). The volume of the entire mass, determined in the process of obtaining its specific gravity, was found to be 20.6 litres.

Professor E. H. S. Bailey of this university is making a thorough analysis of this pallasite, which he will report in detail at the Indianapolis meeting of the American Association for the Advancement of Science. F. H. SNOW.

University of Kansas, Lawrence, Kan., July 9.

A Supposed Footprint in Rock.

IN a field belonging to Mr. J. G. Bemis, in the town of Whitefield, Coös County, N.H., there is a rock of granite upon which is the impression of a man's left foot. It is a naked foot, and has slipped slightly in passing over the rock when in a muddy condition. No one had mentioned this fact to Mr. Bemis when he bought the farm. The rock is like the rest of the rocks in the place, granite. The place is a very solitary one; and probably no one, till Mr. Bemis came, who is a man of much observation, ever observed it.

A sketch made by Professor Grundmann, and specimens of the rock, were shown to Mr. Walter G. Davis, the director of the Meteorological Bureau, Cordoba, South America. He considered it very curious, but, not being a geologist by profession, advised its being brought to notice. The place is two miles north of the village of Whitefield, N.H., not far from The Mountain View House, owned by Mr. W. F. Dodge, and near the estate of the Rev. R. C. Waterston (summer residence). A. W.

BOOK-REVIEWS.

School Supervision. By J. L. PICKARD. (International Education Series.) New York, Appleton. 12°. $1.

THE author of this book has had a long experience as superintendent of education, first in the public schools, and now at the head of a university. He evidently has a natural aptitude for the work; and this, combined with long practice, has enabled him to produce a work on the duties and usefulness of school superintendents which will be very suggestive to those who fill such positions, as well as to educators generally. He maintains in strong terms the importance of good supervision by State, county, and city authorities, and has no difficulty in showing that it has largely promoted the efficiency of the public schools of this country. He devotes comparatively little space to the State and county superintendents, but discusses at length the work of the city superintendent, pointing out its relation to the teachers, the pupils, and the public authorities, with incidental suggestions on every important point. President Pickard fears that the grading and the minute rules for teaching and for the promotion of pupils are making our schools too mechanical, and earnestly advocates leaving greater freedom to both teacher and pupil. The methods of examination, too, he thinks require amendment, so that the examination shall test the pupil's judgment rather than his memory. He favors moral and religious instruction in the public schools, notwithstanding the difficulties arising from the conflicting views of the various religious sects. His mode of presenting his thought is somewhat marred by a too free use of metaphorical

illustration, and his subject is one that cannot be made exactly entertaining; but all who are interested in the practical working of our public-school system will like to read his book.

AMONG THE PUBLISHERS.

THE Alvarenga prize of the College of Physicians of Philadelphia, consisting of one year's income of the bequest of the late Señor Alvarenga of Lisbon, has been awarded to Dr. R. W. Philip of the Victoria Dispensary for Consumption and Diseases of the Chest, Edinburgh, for his essay on pulmonary tuberculosis, which will be published by the college.

— Harper & Brothers have just ready "The Aztec Treasure House," by Thomas Janvier, who, in the form of romance, gives the result of many years of unremitting labor, and furnishes reliable facts regarding Yucatan and Mexico, put together with his special knack at artistic color in word-painting.

—In consequence of his having been appointed sole agent in America for the Religious Tract Society's publications, Fleming H. Revell announces the following periodicals published by the society: *The Leisure Hour*, *The Sunday at Home*, *The Boy's Own Paper*, *The Girl's Own Paper*.

—"A Story of Damon and Pythias," by A. Cressy Morrison, has been issued by the Pabst Brewing Company, Milwaukee, Wis. This little book will interest many of our readers, especially as it is illustrated with a half-dozen views, admirably reproduced, of scenes on the Island of Sicily. Doubtless copies can be had on application to the publishers.

—D. C. Heath & Co., Boston, will add to their series of German texts in a few days, "Selections from Heine's Poems," edited, with an introduction and notes, by Horatio S. White, professor of the German language and literature in Cornell University. This volume will embrace selections not only from the more familiar "Buch der Lieder," but also from Heine's later and posthumous poems, an examination of which is essential to complete the picture of his matured genius.

—We learn from *Nature* of July 3 that Messrs. Mawson, Swan, & Morgan propose to issue a lithographed facsimile of an old manuscript volume of apothecaries' lore and household recipes, which was discovered some years ago among the papers belonging to the old firm of Gilpin & Co., chemists, Pilgrim Street, Newcastle. Careful examination, in which some of the curators of the British Museum have assisted, shows that the manuscript dates from about the time of Queen Elizabeth, additions having been made from time to time, in various handwritings, up to the middle of last century.

—Messrs. Macmillan & Co. have nearly ready for publication two works of great interest to students of ornithology, both of American origin. The first is a treatise on the "Myology of the Raven," intended as an introduction to the study of the muscular system in birds, by Dr. R. W. Shufeldt of the Smithsonian Institution. The second is a revised re-issue, in one volume of convenient size, of the very valuable monographs on field ornithology and on general ornithology, which were prefixed to Dr. Elliott Coues's monumental "Key to North American Birds." Part I., on field ornithology, contains the necessary instructions for the observation and collection of birds in the field, and for the preparation and preservation of specimens for scientific study. Part II. is a technical treatise on the classification, the zoölogical characters, and the anatomical structure of the class of birds, in which the examples cited in illustration of the principles of ornithology have for the most part been re-drawn by the author from British instead of American birds.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

A ZOOLOGIST, acquainted with the United States, graduate (Ph.D. Freiburg, B.Sc. of an English university) of many years' standing; late Fellow of an English college; late assistant to a German university, professor of Comp. Anatomy; many years a student at two German universities; pupil of Huxley, Kölliker, Semper, Wiedersheim and Weismann; author of many well-known memoirs on Comp. Anatomy and Embryology; thoroughly conversant with all branches of the subject; fond of teaching, with good testimonials, seeks a Professorship. Address "MORPHOLOGIST," Office of SCIENCE. Other information and a few testimonials can be seen at the Office of SCIENCE.

AN EXPERIENCED TEACHER desires to hear of a town in which he can establish a high school. Or, he will lease an academy. Address, G., Lock Box 19, Suffern, N. Y.

WANTED.—By a lady-graduate of Cornell University, position as teacher in high school, seminary or college; prepared to teach the following branches, employing, so far as is practicable, the laboratory method: Geology, Botany, Zoölogy, Physiology; also, if desired, Physics, Chemistry, Logic and Psychology. References to heads of above-named departments in Cornell University. JENNIE T. MARTIN, care Cornell University, Ithaca, N. Y.

A GENTLEMAN of experience, highly recommended, liberally educated at home and abroad, desires to correspond with parties needing an instructor in the classics or modern languages in a high-grade institution. Address EARLHAM, Germantown, Pa.

WANTED.—At the Bryant Summer School, Roslyn, L. I., a Lady to teach Sea-Life, and other Sciences. July 8–Sep. 8. Ten weeks to six months according to her convenience. Other papers please copy. E. HINDS, A.M., Principal.

WANTED—Information concerning the production of Mushrooms in caves and other places. Address M. H. CRUMP, care Ky. Geological Survey, Frankfort, Ky.

A YOUNG MAN, graduate from an American College, who has studied a year in Germany, and is now studying in Paris, would like professorship in chemistry. References from some of the best chemists. Address CHARLES E. LINEBARGER, Post-Restante, Paris, France.

WANTED.—An opportunity to study qualitative analysis in or near New York City during the summer. W. J. L., 130 Spring st., Sing Sing, N.Y.

ASSAYER.—Wanted position as above, has had three years' practical experience in a London firm of assayers to the Bank of England, Royal Mint, etc., etc. Thorough knowledge of bullion assaying, and of gold, silver and lead ores. I. FRED. JOHNSON, Northgate Brewery, Canterbury England.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

For exchange—14 volumes (1883-1889) American Journal of Science, 10 volumes (1880-1889) American Naturalist, 21 volumes (1879-1890) English Mechanic, all in good condition for binding; also, Morris Typewriter. Wants first-class microscope, camera, chemical or physical apparatus. Address, with full particulars, E. R. Chadbourn, Lewiston, Maine.

Wanted.—To exchange land and fresh-water mollusca, (principally *Helices Achatinellae*, Clausiliae and Limnaeae,) for those not in my collection. Lists exchanged. Address E. H. White, Box 200, Astoria, Or.

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted—To furnish roots of *Dodecatheon Meadia*, *Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson New Wilmington Pa.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

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THE MOST DESTRUCTIVE TORNADOES SINCE 1872.

A GOOD many rather imperfect lists have been published from time to time, which have not had sufficient care manifested in their collation. There are several peculiar difficulties which one meets in this work. For example: each of three different men at three towns makes a report of a tornado, presumably in the town. One makes the property loss $25,000, and the number of killed, 8; while the second makes these $100,000 and 9, and the third $200,000 and 12, respectively. Fortunately a request was made for the names of the persons killed, and it was found that 8 of them were the same in all three reports, showing that the same tornado had been described. It would have been a very easy matter to have considered the loss of life 29, and of property $325,000, if these had been regarded as different. In another case there were found four tornado lists, two of them containing over 2,000 in each list. One of these was given as occurring near Erie, Penn., on July 26, 1875, in the afternoon. The condition before the storm was "very sultry," and after it, "chilly;" the destructive winds had a motion first from "south-west," then "north-west, west, and north;" while the rain was given as falling "after" the tornado. One hundred and thirty-four lives were lost, and property valued at $500,000 was destroyed. This whole account was so circumstantial and straightforward, that it was very remarkable to find no mention of such a destructive storm in the *Weather Review*. After a search of a good many days, it was at last found that this loss of life and property occurred from a flood near Pittsburgh, Penn., on July 26, 1874.

The *Weather Review* has been appealed to in determining what storms should go into the list below, as it does not appear probable that any notable tornado would be overlooked in that. The criterion for destructiveness has been not entirely the loss to structures, but the violence of the storm, the loss of life, etc., have entered into the estimate. It is not expected that this list will prove entirely satisfactory: in fact, it has already been changed slightly since its first preparation in June, 1889. The utmost pains have been taken to make it reliable, and, if there has been any error, it has been in the line of allowing too much loss rather than too little in any individual case.

(1) Nov. 22, 1874. Tuscumbia, Colbert County, Ala. (scale 3).—Struck the town at 6 P.M.; nearly half the town of 1,400 inhabitants destroyed; 10 persons killed, and 30 wounded; 100 buildings damaged or destroyed; loss, $100,000 (estimated).

(2) May 6, 1876. Chicago, Cook County, Ill. (scale 3).—Moved from south-west to north-east, accompanied by rain, thunder, and lightning; bounding like a ball, it apparently reached the ground but two or three times; loss, $250,000.

(3) June 4, 1877. Mount Carmel, Wabash County, Ill. (scale 3+).—200 to 400 feet wide; great destruction of property; 16 killed, 100 wounded; loss, $400,000.

(4) July 7, 1877. Pensaukee, Oconto County, Wis. (scale 3).—Moved from north-west to south-east, lasting about 2 minutes; 8 killed, many wounded; loss, $300,000.

(5) June 1, 1878. Richmond, Ray County, Mo. (scale 3).—Entered the town at 4.5 P.M. from the south, sweeping every thing clean; heavy sills 18 inches square and 16 feet long were swept away; path through the city 750 feet wide and 1 mile long, in which space not a single house was left; 13 killed, 70 wounded; 100 buildings damaged or destroyed; loss, $100,000 (estimated).

(6) Aug. 9, 1878. Wallingford, New Haven County, Conn. (scale 3+).—At 5.45 P.M. a dark cloud approached from the west; "electricity of the most terrific kind filled the air;" "straight rods of fire came down from the sides of the cloud to the earth; the *débris* of houses was scattered along in parallel lines, as though a mighty river had passed; the greatest destruction occurred in a path 400 feet wide and half a mile long; 34 killed, 70 wounded; 40 dwellings, 50 barns, 1 church, and 1 schoolhouse were destroyed or badly damaged; loss, $200,000.

(7) April 14, 1879. Collinsville, Madison County, Ill. (scale 3—).—Struck town at 2.45 P.M.; nearly every gravestone in cemetery was levelled; 1 killed, several wounded; 60 buildings destroyed; loss, $50,000.

(8) April 16, 1879. Walterboro, Colleton County, S.C. (scale 3).—Rainfall after tornado, which struck at 3.45 P.M., was unprecedented; wind on north side had a downward crushing tendency, on the south side an upward lifting action; 4 people saw balls of lightning running along the ground; 16 killed; 50 buildings destroyed; loss, $200,000.

(9) March 4, 1880. Indianapolis, Marion County, Ind. (scale 3—).—Moved from south-west to north-east with a zigzag course through the city; loss, $100,000.

(10) April 18, 1880. Fayetteville, Washington County, Ark. (scale 3).—Struck town at 8.30 P.M.; not a building escaped in its path, 90 feet wide, through the

town; 2 killed, 20 to 30 injured; 100 buildings destroyed; loss, $100,000.

(11) April 18, 1880. Marshfield, Webster County, Mo. (scale 3).—Struck at 5 P.M.; near town, trees 3 feet in diameter, for a space several hundred yards wide, were lifted entirely out of the ground; every house in the town of 2,000 people was destroyed or badly damaged; 65 killed, 200 wounded; loss, $110,000.

(12) April 18, 1880. Licking, Texas County, Mo. (scale 3—).—Struck at 8.15 P.M.; entire town, of 388 people, destroyed except 3 houses; 300 left homeless; 1 killed, 17 wounded; 65 houses destroyed; loss, $50,000.

(13) April 18, 1880. Beloit, Rock County, Wis. (scale 3—).—Struck at 5 P.M.; moved from south-west to north-east; several killed, many injured; many houses destroyed; loss, $75,000.

(14) April 24, 1880. Taylorville, Christian County, Ill. (scale 3—).—Struck at 7 P.M.; 6 killed; 25 houses destroyed; loss, $60,000.

(15) April 25, 1880. Macon, Noxubee County, Miss. (scale 3).—Struck at 8.30 P.M.; 22 killed, 72 injured; 55 buildings destroyed; loss, $100,000.

(16) May 10, 1880. Arrowsmith, McLean County, Ill. (scale 3—).—Loss, $100,000.

(17) May 28, 1880. Savoy, Fannin County, Tex. (scale 3—).—Time, 10 P.M.; town almost destroyed; 15 killed, 60 wounded; 48 buildings razed; loss, $50,000.

(18) June 14, 1880. Glendale, Hamilton County, O. (scale 3—).—Time, 8 P.M.; loss, $80,000.

(19) April 12, 1881. Hernando, De Soto County, Miss. (scale 3—).—In some spots hail-stones as large as hen's eggs fell; electricity and thunder not observed; 10 killed; 25 buildings demolished; loss, $50,000 (estimated).

(20) June 12, 1881. Jackson, Andrew County, Mo. (scale 3).—A great deal of destruction occurred at King City, De Kalb County; in county and vicinity, 5 killed; 80 buildings razed; loss, $250,000.

(21) July 15, 1881. New Ulm, Brown County, Minn. (scale 3+).—11 killed, 53 wounded; nearly 300 buildings destroyed or seriously damaged; loss in town, $400,000.

(22) Sept. 24, 1881. Quincy, Adams County, Ill. (scale 3).—Time, 5 P.M.; storm accompanied by terrific lightning and thunder; 9 killed; 21 buildings razed; loss, $100,000.

(23) April 18, 1882. Brownsville, Sabine County, Mo. (scale 3).—Time, 4.20 P.M.; 8 killed; 10 brick houses, 40 others, and 1 school razed; loss, $150,000.

(24) May 8, 1882. McKinney, Cleveland County, Ark. (scale 3—).—50 buildings destroyed; loss, $30,000.

(25) May 8, 1882. Mount Ida, Montgomery County, Ark. (scale 3—).—Time, 5.30 P.M.; 2 killed; 100 buildings demolished; loss, $50,000.

(26) June 17, 1882. Grinnell, Poweshiek County, Io. (scale 3+).—Time, 8.45 P.M.; 60 killed, 150 injured; 140 houses reduced to ruins in 5 minutes; loss, $600,000.

(27) April 22, 1883. Beauregard, Copiah County, Miss. (scale 3+).—Time, 3 P.M.; every house and store destroyed in the town of 600 people; solid iron screw of a cotton-press weighing 675 pounds was carried 900 feet; 29 killed, 40 wounded; loss, $450,000.

(28) April 22, 1883. Wesson, Copiah County, Miss. (scale 3—).—13 killed, 60 injured; 27 houses destroyed; loss, $20,000.

(29) May 13, 1883. Kansas City, Jackson County, Mo. (scale 3).—Time, 8.30 P.M.; 200 houses destroyed; loss in town and vicinity, $300,000.

(30) May 13, 1883. Macon City, Macon County, Mo. (scale 3—).—Time, 8.30 P.M.; 5 killed; 107 buildings razed; loss, $150,000. This destruction and loss may include the whole county.

(31) May 18, 1883. Oronogo, Jasper County, Mo. (scale 3—).—6 killed, 33 injured; nearly all houses destroyed; loss, $75,000.

(32) May 18, 1883. Racine, Racine County, Wis. (scale 3—).—Time, 7 P.M.; 16 killed, 100 injured; loss, $75,000.

(33) June 2, 1883. Greenville, Hunt County, Tex. (scale 3—).—Time, 7.15 P.M.; 1 killed, several wounded; 40 houses razed; loss, $70,000.

(34) June 11, 1883. Brush Creek, Fayette County, Io. (scale 3—).—Town one-third destroyed; loss, $40,000.

(35) Aug. 21, 1883. Rochester, Olmstead County, Minn. (scale 3).—Time, 6.36 P.M.; large part of town destroyed; 26 killed; 135 houses destroyed; loss in county, $200,000.

(36) Feb. 19, 1884. Leeds, Jefferson County, Ala. (scale 3—).—Time, 1.20 P.M.; hail of unusual size; 11 killed, 31 wounded; 27 houses and many barns destroyed; loss, $80,000 (estimated).

(37) April 27, 1884. Jamestown, Greene County, O. (scale 3).—Time, 5 P.M.; 6 killed; two-thirds of buildings destroyed; loss, $200,000.

(38) July 21, 1884. Dell Rapids, Minnehaha County, Dak. (scale 3).—Time, 3.5 P.M.; 7 killed; many buildings destroyed; loss, $100,000.

(39) Sept. 9, 1884. Clear Lake, Polk County, Wis. (scale 3).—Time, 5 P.M.; greater part of town in ruins; 3 killed; 40 buildings destroyed; loss, $150,000.

(40) Aug. 3, 1885. Camden, Camden County, N.J. (scale 3+).—Time, 3.20 P.M.; path from one to two squares wide; 6 killed, 100 injured; 500 houses razed or unroofed; loss, $500,000.

(41) Sept. 8, 1885. Washington Court House, Fayette County, O. (scale 3+).—Time, 7.30 P.M.; width of path, 250 feet; town almost destroyed; 6 killed, 100 injured; 40 business-houses and 200 residences razed; loss, $500,000.

(42) April 14, 1886. Coon Rapids, Carroll County, Io. (scale 3—).—Time, 5.5 P.M.; 1 killed; 32 buildings razed; loss, $55,000.

(43) April 14, 1886. St. Cloud, Stearns County, and Sauk Rapids, Benton County, Minn. (scale 3+).—74 killed, 136 wounded; 138 buildings destroyed; loss, $400,000.

(44) May 12, 1886. Attica, Fountain County, Ind. (scale 3).—Time, 10 P.M.; in vicinity, 9 killed; 200 houses razed; loss, $200,000.

(45) April 15, 1887. St. Clairsville and Martin's Ferry, Belmont County, O. (scale 3). Time, 3.20 P.M.; none killed; about 200 buildings of all kinds demolished; loss, $250,000.

(46) April 21, 1887. Prescott, Linn County, Kan. (scale 3). —Time, 5.30 P.M.; 20 killed, 237 wounded; 330 buildings razed in vicinity; loss, $150,000.

(47) April 22, 1887. Mount Carmel (near), Wabash County, Ill. (scale 3 —).—Time, 6 P.M.; 2 killed, several wounded; every thing in path destroyed; loss, $50,-000.

(48) April 22, 1887. Clarksville (near), Johnson County, Ark. (scale 3).—Time, 6.30 A.M.; 20 killed, 75 to 100 injured in vicinity; loss, $150,000.

(49) June 16, 1887. Grand Forks, Grand Forks County, Dak. (scale 3).—Time, 3.22 P.M.; 4 killed; 50 or more houses, besides hundreds of barns, etc., razed; loss, $150,000.

(50) Feb. 19, 1888. Mount Vernon, Jefferson County, Ill. (scale 3+).—18 killed, 54 wounded; 100 buildings razed; loss, $400,000.

(51) May 27, 1888. Hillsboro, Hill County, Tex. (scale 3 —).—Many buildings razed; loss, $100,000.

(52) Aug. 21, 1888. Wilmington, New Castle County, Del. (scale 3).—1 killed, 20 wounded; loss $100,000 to $200,000.

(53) Jan. 9, 1889. Brooklyn, Kings County, N.Y. (scale 3).—Time, 7.40 P.M. (Eastern); width, 500-600 feet; length, 2 miles; whirl from right to left; roar heard 10 or 15 minutes before; loss, $300,000.

(54) Jan. 9, 1889. Reading, Berks County, Penn. (scale 3). —Time, 5.40 P.M.; swept from west to east in a path 60 to 100 feet wide; wind often seemed to crush from above; 40 killed; loss, $200,000 (estimated).

(55) Jan. 12, 1890. St. Louis, St. Louis County, Mo. (scale 3).—Time, 4 P.M.; moved to north-east in a path 500 to 2,000 feet wide; heavy rain for 3 minutes; greatest damage where path was narrowest; 3 killed; 100 houses razed; loss, $250,600.

(56) March 27, 1890, Metropolis, Massac County, Ill. (scale 3 —).—1 killed, 50 injured; loss, $150,000.

(57) March 27, 1890. Louisville, Jefferson County, Ky. (scale 3+).—Time, 7.57 P.M.; path at beginning 600 feet, as it left the city 1,500 feet; cloud did not quite reach the earth; great damage to property; 76 killed, 200 injured; loss, $2,250,000.

This list comprises all the most destructive storms that have been reported, as far as a definite locality was mentioned. It has been found exceedingly difficult to determine the loss in many cases, because an estimate has evidently been made of the loss to crops, orchards, etc., from the rain, hail, and floods that accompanied the tornado, and not from the wind itself. Again, the loss reported evidently referred to a large region in the county, and not to any specific town. Some of these may be enumerated as follows:—

DATE.	COUNTY.	STATE.	LOSS.
June 12, 1881	DeKalb and others.	Missouri.	$200,000
Nov. 5, 1883	Greene and others.	Missouri.	150,000
Nov. 21, 1883	Izard.	Arkansas.	300,000
April 14, 1886	Cass.	Iowa.	160,000
May 11, 1886	Pettis and others.	Missouri.	500,000
May 12, 1886	Greene and others.	Ohio.	1,000,000
May 14, 1886	Hardin and others.	Ohio.	720,000
May 14, 1886	Huron.	Ohio.	500,000
May 14, 1886	Seneca.	Ohio.	300,000
May 14, 1886	Mercer.	Ohio.	250,000

It is highly probable that in some of these cases the losses from one county have been estimated in another, though this has been avoided as much as possible. It is very much to be hoped that more definite estimates will be made in the future. The loss to structures by the wind should be carefully distinguished from the loss of every other kind, by hail or flood, and to crops, stock, or orchards. I shall be very grateful to any who will send me corrections to this list, or add other tornadoes. H. A. HAZEN.

LIGHTNING-CONDUCTORS FROM A MODERN POINT OF VIEW.[1]

A LIGHTNING-CONDUCTOR used to be regarded as a conduit or pipe for conveying electricity from a cloud to the ground. The idea was, that a certain quantity of electricity had to get to the ground somehow; that if an easy channel were opened for it the journey could be taken quietly and safely, but that if obstruction were opposed to it violence and damage would result. This being the notion of what was required, a stout copper rod, a wide-branching and deep-reaching system of roots to disperse the charge as fast as the rod conveyed it down, and a supplement of sharp points at a good elevation to tempt the discharge into this attractive thoroughfare, were the natural guaranties of complete security for every thing overshadowed by it. Carrying out the rain-water-pipe analogue, it was natural also to urge that all masses of metal about the building should be connected to the conductor, so as to be electrically drained to earth by it; and it was also natural to insist on very carefully executed joints, and on a system of testing resistance of conductor and "earth," so as to keep it as low as possible. If ever the resistance rose to 100 ohms, it was to be considered dangerous.

The problem thus seemed an easy one, needing nothing but good workmanship and common sense to make accidents impossible. Accordingly, when, in spite of all precautions, accidents still occurred; when it was found that from the best-constructed conductors flashes were apt to spit off in a senseless manner to gun-barrels and bell-ropes, and wire fences and water-butts,—it was the custom to more or less ridicule and condemn either the proprietor of the conductor, or its erector, or both, and to hint that if only something different had been done,—say, for instance, if glass insulators had not been used, or if the rod had not been stapled too tightly into the wall or if the rope had not been made of stranded wires, or if copper had been used instead of iron, or if the finials had been more sharply pointed, or if the earth-plate had been more deeply buried, or if the rainfall had not been so small, or if the testing of the conductor for resistance had been more recent, or if the wall to which the rod was fixed had been kept wet, etc.,—then the damage would not have happened. Every one of these excuses has been appealed to as an explanation

[1] By Professor Oliver J. Lodge (from Industries).

of a failure: but because the easiest thing to abuse has always been the buried earth connection, that has come in for the most frequent blame, and has been held responsible for every accident not otherwise explicable.

All this is now changing or changed. Attention is now directed, not so much to the opposing charges in cloud and earth, but to the great store of energy in the strained dielectric between. It is recognized that all this volume of energy has somehow to be dissipated, and that to do it suddenly may be by no means the safest way. Given a store of chemical energy in an illicit nitroglycerine factory, it could be dissipated in an instant by the blow of a hammer; but a sane person would prefer to cart it away piecemeal, and set it on fire in a more leisurely and less impulsive manner. So, also, with the electrical energy beneath a thundercloud. A rod of copper an inch or a foot thick may be too heroic a method of dealing with it; for we must remember that an electric discharge, like the recoil of a spring or the swing of a pendulum, is very apt to overshoot itself, and is by no means likely to exhaust itself in a single swing. The hastily discharged cloud (at first, suppose, positive) over-discharges itself, and becomes negative; this again discharges and over-discharges till it is positive, as at first; and so on, with gradually diminishing amplitude of swing, all executed in an extraordinarily minute fraction of a second, but with a vigor and wave-producing energy which are astonishing: for these great electrical surgings, occurring in a medium endowed with the properties of the ether, are not limited to the rod or ostensible conduit. The disturbance spreads in all directions with the speed of light; and every conducting body in the neighborhood, whether joined to the conductor or not, experiences induced electrical surgings to what may easily be a dangerous extent: for not only is there imminent danger of flashes spitting off from such bodies for no obvious reason, — splashes which, on the drain-pipe theory, are absolutely incredible; flashes sometimes from a perfectly insulated, sometimes from a perfectly earthed, piece of metal, — but, besides this, remember that near any considerable assemblage of modern dwellings there exists an extensive metallic ramification in the gas pipes, that these are in places eminently fusible, and that the substance they contain is readily combustible.

On the drain-pipe theory, the gas-pipes, being perfectly earthed, would be regarded as entirely safe so long as they were able to convey the current flowing along them without melting; but, on the modern theory, gas-pipes constitute a widely spreading system of conductors, able to propagate disturbance under ground to considerable distances, and very liable to have some weak and inflammable spot at places where they are crossed by bell-wires, or water-pipes, or any other metallic ramification.

Above ground we have electrical waves transmitted by the ether, and exciting surgings throughout a neighborhood by inductive resonance. Below ground we have electrical pulses conveyed along conductors, leaking to earth as they go, but retaining energy sufficient to ignite gas, whenever conditions are favorable, at considerable distances.

The problem of protection, therefore, ceases to be an easy one, and violent flashes are to be dreaded, no matter how good the conducting-path open to them. In fact, the very ease of the conducting-path, by prolonging the period of dissipation of energy, tends to assist the violence of the dangerous oscillations. The drain-pipe theory, and the practical aphorisms to which it has given rise, would serve well enough if lightning were a fairly long-continued current of millions of ampères urged by a few hundred volts, or if there were no such thing as electro-magnetic inertia; but seeing that the inverse proportion between ampères and volts better corresponds to fact, and seeing that the existence of electro-magnetic inertia is emphasized by multitudes of familiar experiments, the drain-pipe theory breaks down hopelessly, and only a few of its aphorisms manage to survive it.

What, then, are we to set up in place of this shattered idol? First of all, we can recognize what was virtually suggested by Clerk Maxwell, — that the inside of any given enclosure, such as a powder-magazine or dynamite-factory, can, if desired, be absolutely protected from internal sparking by enclosing it in a metallic cage or sheath, through which no conductor of any kind is allowed to pass without being thoroughly connected to it. The clear recognition of the exact, and not approximate, truth of this statement is a decided step in advance, and ought to be satisfactory to those who have to superintend the practical protection of places sufficiently dangerous, or otherwise important, to make the aiming at absolute security worth while. Similarly, for wire-covered ocean-cables absolute protection is possible; but not for ordinary buildings, any more than for ordinary land telegraph-offices, is such a plan likely to be adopted in its entirety. Some approximation to the cage system can be applied to ordinary buildings in the form of wires along all its prominent portions; and such a plan I have suggested, and I understand it is being carried out, for the entrance towers and part of the main body of the present Edinburgh electrical exhibition, Mr. A. R. Bennett having asked me to recommend a plan to the committee as a sort of exhibit. For chimneys a set of four galvanized iron wires, joined by hoops at occasional intervals, and each provided with a fair earth, seems a satisfactory method; but it is to be noted that a column of hot air constitutes a surprisingly easy path, and that it is well to intercept a flash on its way down the gases of a chimney by a copper hoop or pair of hoops over its mouth. Mr. Goolden tells me that he has just applied this method to a new chimney at his works in the Harrow Road. For ordinary houses, a wire down each corner and along the gables is as much as can be expected. At many places even this will not be done. A couple of vertical wires from the highest chimney-stacks on opposite sides must be held better than nothing or than only one.

Earths will be made, but probably they will be simple ones, entailing no great expense. A deep, damp hole for each conductor, with the wire led into it, and twisted round an old harrow or a load of coke, may be held sufficient. And as to terminals, rudely sharpened projections as numerous as is liked may be arranged along ridges and chimney-stacks; but I have at present no great faith in the effective discharging-power of a few points, and should not be disposed to urge any considerable expense in erecting or maintaining them. Crowns of points on chimneys and steeples are certainly desirable, to ward off, as far as they can, the chance of a discharge; but a multitude of rude iron ones will be more effective than a few highly sharpened platinum cones. I find that points do not discharge much till they begin to fizz and audibly spit; and, when the tension is high enough for this, blunt and rough terminals are nearly as efficient as the finest needle-points. The latter, indeed, begin to act at comparatively low potentials; but the amount of electricity they can get rid of at such potentials is surprisingly trivial, and of no moment whatever when dealing with a thunder-cloud.

But the main change I look for in the direction of cheapness and greater universality of protection is in the size and material of the conducting-rod itself. No longer will it be thought necessary to use a great thick conductor of inappreciable resistance: it will be perceived that very moderate thickness suffices to prevent fusion by simple current strength, and that excessive conducting-power is useless.

In the days when the laws of common "divided circuits" were supposed to govern these matters, the lightning-rod had to be of highly conducting copper, and of such dimensions that no other path to earth could hope to compete against it. But now it is known that low resistance is no particular advantage: it is not a question of resistance. The path of a flash is a question of impedance; and the impedance of a conductor to these sudden rushes depends very little on cross-section, and scarcely at all on material. A thin iron wire is nearly as good as a thick copper rod; and its extra resistance has actually an advantage in this respect, that it dissipates some of the energy, and tends to damp out the vibrations sooner. Owing to this cause, a side-flash from a thin iron wire is actually less likely to occur than from a stout copper rod.

The only limit is reached when the heat generated by the current fuses the wire, or runs the risk of fusing it; but, in so far as oscillations are prevented, the mean square of current strength on which its heating-power depends is diminished. Accordingly, a fairly thick iron wire runs no great risk of being melted. Its outer skin may, indeed, be considerably heated; for these sudden

currents keep entirely to the outer skin, penetrating only a fraction of a millimetre into iron, and they make this skin intensely hot. But the central core keeps cool until conduction has time to act; and consequently, unless the wire is so thin as to be bodily deflagrated by the discharge, its continuity is not likely to be interrupted. Thickness of wire is thus more needed in order to resist ordinary deterioration by chemical processes of the atmosphere than for any other reason.

But the liability to intense heating of the outer skin should not be forgotten, and care should be taken not to take the wire past readily inflammable substances for that reason. For instance: it would be madness to depend on Harris's notion that a lightning-conductor through a barrel of gunpowder was perfectly safe, especially if said conductor were an iron wire or rod.

In the old days a lightning-conductor of one or two hundred ohms resistance was considered dangerously obstructive, but the impedance really offered by the best conductor that ever was made to these sudden currents is much more like 1,000 ohms. A column of copper a foot thick may easily offer this obstruction, and the resistance of any reasonably good earth connection becomes negligible by comparison. A mere wire of copper or iron has an impedance not greatly more than a thick rod, and the difference between the impedance of copper and iron is not worth noticing.

But although, in respect of obstructing a flash, copper and iron and all other metals are on an approximate equality, it is far otherwise with their resistances, on which their powers of dissipating energy into heat depend. It is generally supposed that iron resists seven times more than copper of equal section, and so it does steady currents; but to these sudden flashes its resistance is often a hundred times as great as copper, by reason of its magnetic properties. This statement is quite reconcilable with the previous statement, that in the matter of total obstruction there is very little to choose between them: the apparent paradox is explicable by the knowledge that rapidly varying currents are conveyed by the outer skin only of their conductor, and that the outer skin available in the case of magnetic metals is much thinner than in the case of non magnetic.

Questions about shape of cross-section are rather barren. Thin tape is electrically better than round rod, but better than either is a bundle of detached and well-separated wires (for instance, a set of four, one down each cardinal point of a chimney); but it is easy to overestimate the advantage of large surface as opposed to solid contents of a conductor. The problem is not a purely electrical one: it is rather mixed. The central portion or core of a solid rod is electrically neutral, but chemically and thermally and mechanically it may be very efficient. It confers permanence and strength; and the more electrically neutral it is, the less likely is it to be melted. Its skin may be gradually rusted and dissolved off, or it may be suddenly blistered off by a flash; but the tenacity of the cool and solid interior holds the thing together, and enables it to withstand many flashes more. Very thin ribbon or multiple wire, though electrically meritorious, is deficient in these commonplace advantages.

There were two functions attributed to high conducting-power in the old days, — first, the overpowering of all other paths to earth; second, the avoidance of destruction by heat. The first we have seen to be fallacious: on the second a few more explanations can be made. In so far as fusion by simple current strength is the thing dreaded, it must be noticed that a good conductor has no great advantage over a bad conductor. It is a thing known to junior classes, that, when a given current has to be conveyed, less heat is developed in a good conductor, but that, when an electromotive force is the given magnitude, less heat is developed in a bad conductor. The lightning problem is neither of these, but it has quite as much relationship to the second as to the first. There is a given store of energy to be got rid of, and accordingly the heat ultimately generated is a fixed quantity. But the rise of temperature caused by that heat will be less in proportion as the production of it is slow; and though by sudden discharge a quantity of the energy can be made to take the radiant form, and spread itself a great distance before final conversion into heat, instead of concentrating itself on the conductor, yet this cannot be thought an advantage, for, just as in the old days a lightning-rod was expected to protect the neighborhood at its own expense by conveying the whole of a given charge to earth, so now it must be expected to concentrate energy as far as possible on itself, and reduce it to a quiet thermal form at once, instead of, by defect of resistance and over-violent radiation, insisting on every other metallic mass in its neighborhood taking part in the dissipation of energy.

The fact that an iron wire, such as No. 5 or even No. 8 B. W. G., is electrically sufficient for all ordinary flashes, and that resistance is not a thing to be objected to, renders a reasonable amount of protection for a dwelling-house much cheaper than it was when a half-inch copper rod or tape was thought necessary.

A recognition of all the dangers to which a struck neighborhood is liable, doubtless prevents our feeling of confidence from being absolute in any simple system of dwelling-house protection; but at the same time an amount of protection superior to what has been in reality supplied in the past is attainable now at a far less outlay, while for an expenditure comparable in amount to that at present bestowed, but quite otherwise distributed, a very adequate system of conductors can be erected.

Only one difficulty do I see. In coal-burning towns galvanized iron wire is, I fear, not very durable, and renewal expenditure is always unpleasant. It is quite possible that some alloy or coating able to avoid this objection will be forthcoming, now that inventors may know that the problem is a chemical one, and that high conductivity is unnecessary.

NOTES AND NEWS.

THE seventh annual meeting of the Association of Official Agricultural Chemists, by a vote of a majority of the executive committee, is called to meet in Washington, in the lecture-room of the National Museum, at 10 A.M., on the 28th of August proximo.

— Professor R. S. Woodward, for many years chief geographer of the United States Geological Survey, has been appointed assistant in the Coast and Geodetic Survey. Professor Woodward was for ten years assistant engineer on the United States Lake Survey, and was assistant astronomer of the United States Transit of Venus Commission previous to his connection with the Geological Survey. He was chairman of the Section of Mathematics and Astronomy of the American Association for the Advancement of Science in 1889, and is widely known for his investigations in mathematics, astronomy, and physics. His appointment to the Coast and Geodetic Survey is a subject for congratulation on both sides.

— Records have been received, at the office of the United States Coast and Geodetic Survey, of observations made during the last cruise of the "Pensacola." The stations include the West Coast of Africa, and some islands in the North and South Atlantic. The work was done by an officer of the survey, Assistant E. D. Preston, aided by members of the ship's company. Gravity and magnetic measures were made at St. Paul de Loanda (Angola), Cape of Good Hope, St. Helena, Ascension, Barbadoes, and Bermuda. In addition, magnetic observations alone were made at the Azores (Fayal), Cape Verde Islands (Porto Grande), Sierra Leone (Freetown), Gold Coast (Elmina), and in Angola at Cabiri. The pendulums used in the gravity work were the ones employed in 1883 in Polynesia, and in 1887 at the summit of Haleakala and other stations in the Hawaiian Islands. The computations are now under way at the office in Washington.

— Mr. Ward McAllister called at the office of the Cassell Publishing Company, New York, the day before he left New York for his farm at Newport, and delivered the manuscript of his book, "Society as I have found it," into the hands of the president of the company. Since he decided to write the book, Mr. McAllister has worked on it every day, and only completed it in time to leave town before the Fourth of July. A glance at the manuscript shows that it will more than fulfil the expectations of the public. No more interesting volume of its kind has been written since

Lord Chesterfield's letters, which it strongly resembles, for it combines reminiscence with instruction, precept and anecdote running side by side through its pages. A portrait of Mr. McAllister, taken expressly for the purpose, will form the frontispiece of the book.

— At the third summer meeting of university extension and other students, which is to be held at Oxford in August, as stated in *Nature*, Mr. E. B. Poulton, F.R.S., will lecture on the influence of courtship on color, and Mr. Francis Gotch on the physiology of the nervous system; Professor Patrick Geddes will deal with problems of evolution, organic and social; Professor Green, F.R.S., will give a course on geology; and Mr. C. Carus-Wilson lectures on geological phenomena. "The Teaching of Geography," by Mr. H. J. Mackinder; "Protective Adaptations in Plants," by Mr. J. B. Farmer; and "Some Aspects of Light," by M. V. Perronet Sells, — are also subjects announced in the programme.

— It will be remembered that a set of metric standards, furnished by the International Bureau of Weights and Measures near Paris, was brought to this country last autumn, and that they were formally received by the President of the United States, in the presence of a number of distinguished men. The other set allotted to this government, consisting of Metre No. 21 and Kilogram No. 4, has just been brought from Paris by Assistant O. H. Tittmann, and has been deposited at the office of United States Standard Weights and Measures in the Coast and Geodetic Survey building at Washington.

—Under the auspices of the Royal Dublin Society, and partially aided by government, a scientific investigation of Irish fishing-grounds is now being carried on upon the south-west and west coasts of Ireland, as stated in *Nature* of July 3. The Rev. W. Spotswood Green, her Majesty's inspector of fisheries, Dublin, and Professor A. C. Haddon of Dublin, organized the expedition, which is expected to last four or five months. The screw steamer "Fingal," of Glasgow, 160 tons register, chartered for the cruise, left Queenstown on May 7, having on board Mr. Green, Professor Prince, Mr. T. H. Poole of Cork (special surveyor to the expedition), and a crew of seamen experienced in trawl, net, and line fishing. Professor Prince, who has conducted elaborate investigations upon the embryology of food-fishes at St. Andrews, and, later on, Mr. E W. L. Holt, also of St. Andrews Marine Laboratory, superintended the zoölogical department until Professor Haddon was able to join the steamer. Dr. R. Scharff of the Science and Art Museum, Dublin, and other gentlemen, have temporarily assisted on board. The "Fingal" has been specially fitted up for the work. Several beam-trawls (including patent forms), a quantity of mackerel-nets, thirteen miles of long lines, large tow-nets (after Professor McIntosh's pattern), microscopes and instruments for zoölogical and physical research, are included among the appliances. The coast from Cape Clear to Killybegs Bay (Donegal) has already been traversed, and about thirty stations have been tested, and results of value obtained. In the open sea and in inshore waters the eggs and larval stages of mackerel, ling, gurnard, haddock, turbot, witch, and other species of food-fishes, have been obtained; and a great variety of invertebrates, including some rare echinoderms, annelids, mollusks, etc., have been brought up in the dredge and trawl, the greatest depth tested so far being about a hundred fathoms. The estuary of the Kenmare River, Dingle Bay, Smerwick, Birterburg, and Roundstone Bays, and the harbor of Clifden, proved to be very rich in invertebrate forms, specimens of *Synapta inhœrens* being abundant, while *Bonellia*, *Priapulus*, and many rare mollusks, *Lyonsia*, *Philine*, and various nudibranchs, were procured. Copepods, larval crustaceans, medusæ, echinoderms, and ascidians occurred in such quantities as to frequently cause great inconvenience. A fine example of *Orthagoriscus mola*, nearly nine feet in dorso-ventral measurement, was shot by Mr. Green, and secured; and the rare pleuronectid, *Arnoglossus grõhmanii*, was obtained in Clifden harbor, the second specimen captured in British seas. Deep-sea dredgings will be taken, and it is expected that the reports to be presented at the end of the cruise to the Royal Dublin Society, to the Irish Fishery Department, and the government, will be of unusual scientific interest.

— Mr. W. C. Macdonald, a merchant of Montreal, has just made a munificent contribution to McGill College, says *Nature* of July 10. He has given $150,000 to the law faculty for the endowment of the dean's and another chair, and also $50,000 for the endowment of a chair of experimental physics, and has offered to erect buildings for the faculty of applied science, to include class-rooms and laboratories. Altogether the value of Mr. Macdonald's gift is about $400,000.

— The July number of the *Kew Bulletin* contains further information on the cultivation and preparation of the coloring-substance known as annatto. The present instalment deals with the West African seed, which does not appear to possess the qualities of that from Jamaica. A new method of preserving grain from weevils is suggested, while there is a long correspondence on Colombian india-rubber. The letters contain an account of a tree which yields rubber, and which is known in commerce as *Colombia virgen*. It has the peculiarity of growing at high elevations, and therefore in a comparatively cool climate. Another section deals with the fibre-industry of the Bahamas; and particulars are given of the establishment of the botanical station at Lagos, the first of its kind on the West Coast of Africa. A letter from the curator, Mr. McNair, gives interesting information respecting some of the plants under experimental cultivation there.

— We learn from *Nature* of July 10, that according to the report of the Oxford University extension scheme which has been issued, and which comes up to the commencement of July, "since June, 1889, 148 courses have been delivered in 109 centres by 25 lecturers. Examinations were held at the conclusion of 119 courses, and the examiners have awarded certificates of merit or distinction to 927 candidates The courses were attended by 17,854 students, and the average period of study covered by each course was 10 weeks." In 1885–86 the number of courses delivered was 27 only, and the number of lecture centres, 22. Among the chief signs of progress recorded are (1) a great extension of university teaching in small towns, (2) a marked increase in the number of working men attending the lectures, (3) the arrangement of a number of successful and well-attended courses during the early summer months, (4) the establishment of 36 students' associations at various centres, and (5) the federation in two new districts of the various lecture centres. The students' associations are very valuable, inasmuch as "they encourage the students to undertake regular reading throughout the year in preparation for, or in continuation of, the courses of lectures." The federation movement is also extremely helpful. It enables the difficulty sometimes experienced in procuring lecturers to be more easily surmounted, and it fosters and stimulates local interest in the study undertaken. The committee regrets that a greater proportion of students do not present themselves for examination; but those who do go through the ordeal appear, on the whole, to come out very creditably. Scholarships are given to the writers of the best essays on a number of subjects connected with those studied during the course; and "among the successful essayists," we are told, "were two carpenters, two clerks, a fustian weaver, an artisan employed in a government dockyard, and three elementary teachers." In an examination recently held, those who were awarded certificates included "a national school-mistress, a young lawyer, a plumber, and a railway signalman." Again, we are informed that "a course of lectures on zoölogy recently given by an Oxford lecturer in Devonshire was attended by a student whose essays convinced the lecturer of her singular powers of accurate and original observation. She was encouraged by the lecturer to undertake a course of systematic study, and at his suggestion became a candidate in the examination for scholarships at Somerville Hall, where she was elected to the second scholarship."

— The latest information of the Russian expedition to Thibet, under the command of Col. Pevtsoff, is contained in the following letter from the mining engineer Bogdanovitch, published by the Russian newspaper the *Messenger of the Volga*, and republished in *Nature* of July 10: "Having happily passed through the winter at Nia, the expedition set out on April 24 to traverse the defile of Idjelik-Khanoum, and thus reach Thibet. Col. Pevtsoff had sent half his camels, carrying 23 bales with his col-

lections, to the banks of the Cherchen River, where they could recover their strength with the abundant pasture. These animals are intended to facilitate our return to Russia. Our baggage will be carried into Thibet on oxen hired for the purpose. We ourselves are riding thither on horseback, carrying with us the light portion of our effects. We left Nia with 30 horses. During the winter M. Roborovsky made an excursion to Cherchen, and I made one to the mountains of Karangon-Fag, south of Khoten. During my tour I met Grombchevsky, who came with me to Khoten in February, and thence returned for a short time to Nia. The health of all the members of the expedition is perfect; and during the winter we have received all our letters and papers from St. Petersburg, thanks to the good offices of M. Petrovsky, our consul at Kashgar. We shall send our collections to Russia through his agency." M. Grombchevsky has informed the military governor of the Syr-Darya district that the time of his journey has been extended until Jan. 15, 1891. His expedition has already traversed about 3,315 miles. M. Grombchevsky will pass the summer in exploring Thibet between Polon-Lhasa and Rudok.

—The occurrence of St. Elmo's fire at sea has been lately studied by Capt. Haltermann of Hamburg, who made examination of a number of ships' log-books for 1884 and 1885, reporting 156 cases in 800 months of observation. He finds, according to *Nature*, a greater number of cases in north than in south latitudes; and of 63 cases observed in the North Atlantic (the stormiest sea in winter), 49 occurred in the months November to April, and only 14 in the other half of the year. Of the total (156), only 27 were unaccompanied by thunder and lightning, and only 6 by precipitates of some kind. Snow and hail showers, with strong wind, seemed specially favorable. Of 133 cases accompanied by rain, there were only 15 without also thunder and lightning; while of 32 with hail, 18 were without thunder and lightning; and of 14 with snow, 12 without thunder and lightning. As to wind, there were instances with all degrees of intensity. The wind was in most cases (beyond 35° latitude) from equatorial direction; and this, with the commonly observed decrease of pressure, indicates that the cases mostly occurred in the front part of depressions. In 46 cases the barometer rose, and in 8 it was unaffected. In most cases the thermometer fell. Between the equator and 10° north latitude, 12 cases were observed, and not one in the corresponding region to the south, where the trade-wind generally prevails. In the region of the constantly blowing trade-wind, St. Elmo's fire is never met with. The western half of seas extending polewards from 30° latitude seems to afford the best conditions. On the whole, the occurrence of St. Elmo's fire may probably be ascribed to the same causes as give rise to thunder and lightning.

— The Lucayan Indians, who inhabited the islands now called the Bahamas, were the first Indians seen by Columbus. In less than twenty years this interesting people, numbering, according to the estimate of the conquerors, forty thousand persons, was wholly exterminated. The hammock was found among the Lucayans; and both the word and the thing were adopted by the Spaniards, through whom they were passed on to other nations. Various skulls have been recovered from caves in the Bahamas, and have been made the subject of a valuable paper by Mr. W. K. Brooks. This paper was read some time ago before the National Academy of Sciences, says *Nature* of July 10, and has now been reprinted as a separate memoir, with carefully executed illustrations. Columbus testifies that the Lucayans were "of good size, with large eyes, and broader foreheads than he had ever seen in any other race of men;" and Mr. Brooks says this agrees perfectly with the results he has reached, the most conspicuous characteristics of the skulls he has examined being the great breadth noted by Columbus, and the massiveness and solidity of the head. "We may therefore unhesitatingly decide," says Mr. Brooks, "that they are the remains of the people who inhabited the islands at the time of their discovery, and that these people were a well-marked type of that North American Indian race which was at that time distributed over the Bahama Islands, Hayti, and the greater part of Cuba. As these islands are only a few miles from the peninsula of Florida, this race must at some time have inhabited at least the south-eastern extremity of the continent; and it is therefore extremely interesting to note that the North American crania which exhibit the closest resemblance to those from the Bahama Islands have been obtained from Florida."

— Mr. James Bennett has, according to the *Colonies and India*, been commissioned by Lord Knutsford to proceed to Lagos, to make full inquiry into and report upon the mineral and vegetable resources of the colony with a view to their further development. Mr. Bennett is the inventor of a special process for extracting, by means of chemicals, pure rubber from the milk of the wild fig-tree, of which several species are to be found in Lagos and the neighborhood, and it seems likely that considerable advantage will accrue to the colony from his visit. Mr. Bennett will devote particular attention to such products as rubber, gums, fibres, and minerals, in which it is thought that the present trade of the colony may be largely increased, or which are considered likely to become subjects of local manufacture.

— The *London Times* gives some details of the new expedition to the north pole, for which the Norwegian National Assembly voted 200,000 kroner on June 30, and which will be under the charge of M. Nansen. Hitherto, with one possible exception, all attempts to reach the north pole have been made in defiance of the obstacles of Nature. It has been an open campaign between the endurance of man and the icy barrier of the Arctic Seas, in which Nature has always been triumphant. On this occasion a systematic and well-organized attempt will be made to ascertain if Nature herself has not supplied a means of solving the difficulty, and if there is not, after all, a possibility of reaching the north pole by utilizing certain natural facilities in these frozen seas of which all earlier explorers were ignorant. The circumstances on which these new hopes are founded may be thus summarized. The "Jeannette" expedition of 1879–81, and the loss of that vessel, seemed to sound the knell of all expeditions to reach the pole by Bering Straits; but in the end the results of that effort are shown to have been more satisfactory and auspicious than any of the officers of the "Jeannette" could have hoped for, when, with extreme difficulty, they succeeded in reaching Siberia across the ice from their wrecked vessel. In June, 1884, exactly three years after the "Jeannette" sank, there were found near Julianshaab, in Greenland, several articles which had belonged to the "Jeannette," and been abandoned at the time of its wreck by the crew, and which had been carried to the coast of Greenland from the opposite side of the Polar Sea on a piece of ice. This fact at once aroused curiosity as to how it accomplished the journey across the Arctic Ocean, and as to what unknown current had borne the message from Bering Straits to Greenland. However these objects reached Julianshaab, they could not have come in an eastern direction, through Smith's Sound, for the only current which reaches Julianshaab is that from the eastern coast of Greenland *via* Cape Farewell and the north. Nor is there much probability that they were borne in a western direction from the place where the "Jeannette" sank, for all the currents round Nova Zembla, Franz-Josef Land, and Spitzbergen are known, and it seems impossible for the ice bearing the relics of the unfortunate "Jeannette" to have traversed the intervening distance in the space of three years, even if it were possible at all. There remains only the alternative, that there is a comparatively short and direct route across the Arctic Ocean by way of the north pole, and that Nature herself has supplied a means of communication, however uncertain, across it. Increased significance to the discovery of the "Jeannette" relics in 1884 was given by the identification in 1886 of bows found on the coast of Greenland with those by the Eskimo in the vicinity of Bering Straits, at Port Clarence, Norton Sound, and the mouth of the Yukon River. M. Nansen's expedition will endeavor to realize these hopes of a direct route across the apex of the Arctic Ocean. A specially constructed boat of one hundred and seventy tons will be built, and provisions and fuel taken for five years, although it is hoped that two will suffice. The expedition will consist of ten or twelve men, and M. Nansen proposes to leave Norway in February, 1892.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

THE DEGENERATION OF THE TECHNICAL SOCIETIES.

THERE is much current discussion of the present condition of the great technical societies in the United States. The older members seem to be somewhat apprehensive lest the fruits of their great labor and zeal in the earlier days, in the formation, especially, of the national societies of engineers, may be sooner or later wholly lost. The discussions at recent conventions of the Society of Civil Engineers, the most venerable of them all, and the criticisms of our exchanges among the technical journals most interested in its work, lead us to suppose that there is a question whether it does not require some such agitation and revolutionary reconstruction as brought it out of its stupor and threatened decadence fifteen years or more ago, to prevent its utter evanescence now. It is said by the agitators, that the number and quality of its papers, and its influence and growth as a national association, are falling off constantly; that local societies are absorbing those who should enter it, and who should form its material of the coming generation, so generally, that it must apparently, unless this retrograde movement be promptly checked, soon lose its old pre-eminence. It is said by the critics that it no longer holds interesting sessions at its central office; nor does it get together, except by robbing its regular meetings, either much or valuable material for its annual conventions. It is said that a few of the older members only, "run" the society; and that the great men of the profession, and the promising young men, do not come in as they should, either submitting papers or taking part in the discussions.

Of the Mining Engineers' Society we hear little of such criticism. But it is sometimes suggested that it is by no means a representative or a professional association; that it includes whoever chooses to join; and that those who thus choose are largely non-professionals, or, at least, that the semi-professionals form a large proportion of its body of members, as well as associates. The criticism made of its publications is, that they often include the purely mercantile rather than the professional and scientific element, and that shop and advertisement are too often mixed with the more instructive and original papers.

Of the mechanical engineers we note the observation, by its special constituency among the journals, that while its growth seems to be healthy and steady, its finances well managed, and its conventions well attended, the reader of its "Transactions" misses the names and the papers of a number of the able men who were in its earlier days regular contributors; while the tone of the discussions has deteriorated, and courtesy and good breeding are sometimes forgotten by too youthful or too earnest disputants.

Of the electrical engineers are said, so far as we have observed, only words of praise; though the remark is made that its membership seems to be drawn from among the electricians rather than from the engineers of the great body of electrical engineers who are its natural recruits. Many and excellent papers are presented relating to the dynamo and its physics; few relating to the dynamo as a piece of engineering, or to the designing and construction of stations, of engines and boilers fitted to this department of work, or the engineering of the distribution of electrical energy.

We presume that in many respects these criticisms are simply the outcome of that spirit of fault-finding which is rife in all young societies and among the "fresh" members, who are more ambitious and earnest than wise or just; but there may be some reason behind it all, and the questions are often asked, How may these societies be made more truly national? How may they be given a more representative character? How may the distinguished and experienced members of each be brought into view, and induced to work with and for their continued growth and improvement? The formation of committees of each of the societies to confer together, and to seek some way in which all can be brought into closer relations, and of other committees looking to the absorption of local societies as chapters of the national body, give color to the suspicion that there may be some cause of criticism, and some opportunity of improvement.

If we might make a suggestion, it would be about as follows: see that the presiding officer and the members of the boards of management are elected invariably from among the oldest and most distinguished of available candidates, and that Benjamin Franklin's principle — "No American citizen has a right to seek office; but no true American citizen will refuse to accept office, when called by his fellows to take a position of honor and responsibility" — be paraphrased, and adapted to the case; see that the wise, experienced, able, and honest members are encouraged to present the best fruits of their labors; and especially see that they are treated respectfully, and fairly and kindly, in all discussions. See the "Transactions" carefully placed in the great libraries, and that the papers going before any meeting are given in advance to the representatives of the technical press; see, also, with especial care, that these journals have capable and discreet representatives at the conventions and meetings; and insure, if possible, with still greater care, their treatment with all courtesy, otherwise no complaint of discourtesy will hold against them or their principals. Let the presiding officer and the secretary see that the slightest rudeness or discourtesy, the least variation from the rules of good manners and good breeding, is instantly reprimanded, and the offender properly dealt with; making it the

habit, as well as the principle, that all discussion must be conducted fairly and kindly, and in a proper spirit, whoever may be on either side the controversy. Make all members of the profession welcome at headquarters; and let them see that they cannot, without injury to their own interests, defer becoming members of so representative and powerful a body of their comrades. We think the observing of these few simple principles will insure prosperity, without changes of constitution.

HEALTH MATTERS.

Chemical Salts developed in Living Organisms.

A MEMOIR by Mr. Robert Irvine and Dr. Sims Woodhead, entitled "Secretion of Carbonate of Lime by Animals," recently published in the "Proceedings of the Royal Society of Edinburgh," deals with the interesting question of the assimilation of food and the development of structures partially composed of a definite proportion of insoluble chemical salts. Thus, hens supplied with sulphate of lime, but no other lime salt, produce well-formed egg-shells composed of carbonate of lime. The process of shell-formation in the crab appears to differ chemically from egg-shell development in the hen. Sulphate of lime is not assimilated in the same manner, so that crabs which throw off their shells in artificial sea water in which sulphate of lime as well as chloride of sodium are present, but from which chloride of calcium is excluded, do not form a new exo-skeleton of carbonate of lime. As soon as chloride of calcium is added, although the sulphate be withheld, shell-formation may go on. The authors of the paper minutely describe the share which epithelial and other cells play in secreting, or causing the deposit of, chemical salts in shells and in bone. The histological and chemical processes differ considerably in bone, in egg-shells, in the shells of crustacea, and in the "mantle" of mollusca.

The Use of Leeches in Bacteriology.

Dr. Pasternatski has found that a very convenient method for collecting and preserving for cultivation the spirillum of relapsing-fever is to use leeches. If the leeches are kept in a cold place, the spirilla they contain preserve their vitality for a considerable period, much longer than they do when kept in capillary or other glass tubes. When exposed for some time to a temperature of from 27° C. to 30° C., the spirilla were found to undergo transformation into other forms.

Lead-Poisoning.

Investigations made this year appear to show, as reported by a contemporary, that the lead-miner does not really suffer in health more than any other worker under ground, as the ore is not in a condition to be absorbed by the body, but that lead-smelters and all engaged in the manufacture of lead, particularly white lead, run a very great risk of being contaminated sooner or later. It also appears that at Tyne-side, the chief centre of the English lead trade, there is one type of ailment which is rarely seen elsewhere, attacking those who have been engaged in the work only a few months, or even weeks, — a fatal disease, the principal victims being girls of from seventeen to twenty-three years of age. They rapidly display symptons of this form of toxemia in the way of severe headache, followed by colic and blindness; and unless they speedily leave work for a considerable period of time, and undergo most careful treatment, the fatal result is rapidly ushered in, usually with epileptiform convulsions and coma. It is remarkable, however, that but little trace of lead is found in their bodies after death, perhaps not more than a few grains in the internal organs, after they have been subjected to the most complete and exhaustive examination.

LETTERS TO THE EDITOR.

Osteological Notes.

VIRGIL never wrote a more truthful or more appropriate line than the one in which he says,

"Felix qui potuit rerum cognoscere causas."

How is the fact to be explained, that, with the exception of a single family, the marsupials have no patella, or, at the best, a very rudimentary one, when all the other orders of the *Mammalia*, as well as certain of the reptiles and birds before them, are thus supplied?

The patella is the largest of the sesamoid bones, and, like the other sesamoids, is developed in the course of a muscle or tendon, wherever marked friction occurs, or where protection or increased leverage is demanded. Placed on the anterior surface of the knee joint in the conjoined tendon of the four extensors of the leg (*quadriceps extensor*), this bone is of a triangular form, its base being turned upwards to receive the above tendon, and its apex downwards to be united by the strong ligament to the tubercle of the tibia.

John Bell says, "The patella is manifestly useful chiefly as a lever, gliding upon the fore-part of the thigh-bone, upon the smooth surface which is betwixt the condyles. The projection of this bone upon the knee removes the acting force from the centre of motion so as to increase the power; and it is beautifully contrived, that while the knee is bent, and the muscles at rest, as in sitting, the patella sinks down concealed into a hollow of the knee. When the muscles begin to act, the patella begins to rise from this hollow; in proportion as they contract, they lose their strength, but the patella, gradually rising, increases the power, and, when the contraction is nearly perfect, the patella has risen to the summit of the knee; so that the rising of the patella raises the mechanical power of the joint in exact proportion as the contraction expands the living contractible power of the muscles."

In the marsupials the patella may be entirely absent, or its place may be supplied by a cartilaginous disk, with occasionally slight specks of bony matter intermingled, or, in some cases, by a simple broadened expansion of the tendon. In only one family, the bandicoots (*Peramelidæ*), is this bone fully developed, and the groove in the femur, for its action, well marked. In the phalangers (*Phalangistidæ*), as also in the native cats (*Dasyuridæ*), the groove is broad and shallow, and the patella but slightly developed, consisting of a moderate thickening of the tendon *quadriceps extensor*.

In the flying phalangers (*Petaurists*), in the native bear (*Phascolarctos cenoreus*), and in the wombat (*Phascolomys*), as well as in the banded ant-eater (*Myrmecobius*), the anterior distal surface of the femur is almost plane from side to side, exhibiting no depression for a patella, which does not exist. In the opossums (*Didelphidæ*) there is a slight thickening of the tendon. In the typical kangaroo (*Macropus*), as well as in the kangaroo rat (*Hypsiprymnus*), the muscular tendon is fairly developed, and the femoral groove correspondingly well marked. Owen says that he has found a small patella in *Macropus bennetti.*

In searching for a solution of the problem thus presented, the low organization of the order of the *Marsupialia* must be especially recognized. They have close affinities with the reptiles and birds (*Sauropsida*), in most of which no patella exists. The presence of this bone in certain lizards among the reptiles, and in certain birds, offers no greater anomaly than its existence solely in one family of the marsupials. Then, again, we find similar provisions made for its absence in the reptiles, birds, and marsupials; viz., a prolongation and modification of that tubercle of the tibia which thus supplies increased leverage.

Moreover, there is nothing observable in the anatomy or in the habits of the bandicoots that would lead us to suppose that they specially needed a normally constructed patella. They are small, rat-like animals, about eighteen inches in length, having a singular gait, which is made up of jumping and running; and they live among stony ridges in the eastern and south-eastern portions of Australia. They are allied in their food to the placental *Insectivora*.

Cope, in his "Hard Parts of the Mammalia," says, "The existence of tibia and fibula of subequal size gave rise to two distal articular surfaces of the femur. The constant use of these in flexion and extension gave them the convexity which they possess in the *Mammalia*, — a process already commenced in the *Reptilia*. The strong tendon of the rectus muscles passing over the anterior face of the extremity gave rise to the rotular groove. This became better defined and more important after the development in placental mammals of a sesamoid bone or patella in the tendon."

The phylogeny of the marsupials is as yet closely surrounded by many doubts, which, however, paleontology is slowly but surely clearing away. It is probable that the earliest mammalian remains so far discovered are marsupial; that is to say, so far as brain and reproductive development are concerned. It is highly probable, also, that the relation between the marsupials and the still lower organized monotremes is a comparatively near one, although, as Marsh says, "we have as yet no hint of the path by which these two groups became separated from the inferior vertebrates." That they did become separated, and that the marsupials at least inherited the characters, more or less modified, which marked their reptilian ancestors, among which may be enumerated the entire absence or incomplete condition of a rotula or patella, there is much reason to suppose. D. D. SLADE.

Cambridge, Mass., July 17.

One of Dr. Hann's Teachings.

HOWEVER much or little the Sonnblick temperature observations of Dr. Julius Hann are going to teach us about the nature and cause of cyclones, I think we may at least profit by the example which he affords us, in the spirit with which he has conducted his discussions of meteorological topics with those who differed from him. In the valuable papers which Professor Abbe translated for the "Smithsonian Report of 1877," Dr. Hann has frequent occasion to reply to his critics, Capt. Hoffmeyer, Reye, and others; and he does so not only in a tone of courtesy, such as a true gentleman would naturally employ, but also with an evident desire, in the interests of science, and quite regardless of personal pride in his own consistency, to reconcile conflicting views as far as possible. Is not this the best way in which to ascertain and establish the truth? RESEARCH.

The Aurora.

IN the course of an extended research in regard to the relation of the aurora to magnetic and solar conditions, in which I have been engaged for several years, the question as to whether atmospheric movements are affected has been considered. Incidentally the matter of tornadoes, touched upon by Professor Hazen in the last of his articles upon that subject thus far published, has been taken into the account. As his table on p. 30 of *Science* for July 18 appears to indicate, at least for the years for which the more complete reports are to be had, a relation of some sort to a disturbed condition of the sun appears to exist. His method of attempting to show in detail the "specific influence of spots" is not, however, quite complete. For instance: the glowing eruptions known as the *faculæ* are far more intimately related to magnetic storms, and presumably other phenomena, than are the spots. It is not my purpose to enter upon the discussion in detail at present. Tables are in existence, and in process of verification, which may one day be published if found complete after searching tests to which they are being submitted. Enough has been learned to warrant the positive affirmation that this subject has not yet been exhausted. Certainly there is room for improvement in knowledge of the causes of sudden intensification of storm energy. M. A. VEEDER.

Lyons, N.Y., July 21.

BOOK-REVIEWS.

Contributions to American Educational History, Nos. 8 and 9. Ed. by HERBERT B. ADAMS. Washington, Bureau of Education. 8°.

THE first of these pamphlets is a "History of Education in Alabama," by Willis G. Clark, and is mainly devoted to the University of Alabama and other collegiate institutions. The history of the State University is recounted at tedious length, and with a particularity out of all proportion to its importance. The other institutions, both colleges and academies, are more briefly dealt with, while the public schools are dismissed with a very short notice indeed. The system of public education is of very recent growth; and even now, as Mr. Clark states, the schoolhouses are altogether insufficient to accommodate the pupils. What the real quality of the various schools is, it is impossible from this pamphlet to clearly make out. In treating of the University of Alabama, for instance, Mr. Clark has a great deal to say about the finances of the institution, the lives of the various professors, the quarrels between professors and students, and other matters of minor importance; but what the course of study there actually is, how strictly it is pursued, and how the education furnished there compares with that given by other universities, Mr. Clark does not sufficiently inform us. Yet these are just the things that readers most wish to know. As far as it goes, however, his work seems to have been carefully and conscientiously done.

The other pamphlet in our hands is "The History of Federal and State Aid to Higher Education in the United States," by Frank W. Blackmar. It begins by recounting what the general government has done in this direction, partly by land grants to the States for educational purposes, and partly by the establishment and maintenance of the Smithsonian Institution, the Naval and Military Academies, the Library of Congress, and other institutions of an educational character. Then, taking up the States in detail, it shows what each of them has done in founding and maintaining colleges and universities, and also agricultural and technical schools. Mr. Blackmar has used much care and diligence in collecting his facts, and his work will be useful for reference; but it cannot be called a readable book. It is, in short, a mere catalogue of facts, set forth in a dry and technical style; and it does seem as if the subject might have been treated in a more interesting manner.

Reflections on the Motive Power of Heat and on Machines fitted to develop that Power. By N. L. S. CARNOT. Tr. by R. H. Thurston. New York, Wiley. 12°. $2.

BOTH publisher and author, in the case of this book, disclaim any expectation of reaping large pecuniary reward. Yet there are many reasons why this first English translation of a scientific work, that lay buried and unknown for many years till Sir W. Thomson chanced on it, and found in it the true explanation of the mode of working of the steam-engine, should have a place in every library where such epoch-marking books are to be expected.

The Carnot whose contributions to physical science are made public in this volume was born in the smaller palace of Luxembourg, June 1, 1796. His father was prominent in the political life of France during the close of the last century, and his grand-nephew of the same name — Sadi Carnot — is now president of the French republic. He early manifested an interest in mechanics, which induced his father to give a scientific bent to his son's education. Naturally, in the absence of the polytechnic schools of the present day, this education was obtained in the military schools. As a result, Sadi Carnot, at the age of twenty-three, found himself in Paris on a long furlough, which gave him the leisure and opportunities for study which he had earnestly desired.

He diligently followed the course of the College of France and of the Sorbonne, of the École des Mines, of the Museum, and of the Bibliothèque. His interest in mechanics led him to the workshops, and in the fine arts to the study of painting and music.

In 1826 a return to active military duties was necessitated; but two years later, Sadi Carnot laid aside his uniform, that he might be free.

It was before this time, in 1824, that the paper on the motive power of heat was published. He had noticed how little advance had been made in steam-engines, and that such advances as were accomplished had come largely as the result of accident. It must be remembered that at that time the conservation of energy was unknown. This Carnot first suspected and then established, so far as the conversion of heat into work was concerned. Yet the scientific atmosphere of his time was so saturated with the idea that heat was material, that he made no use of this conversion of heat into work in his typical heat-engine, now so well known as Carnot's engine. He allowed the prevailing errors to dominate him in this wonderful elucidation of the essentials of an engine that shall give work for heat. Not only did he show the necessity of having a hot body and a cold body for the working of a

heat-engine, but he showed the limitations to the efficiency of such an engine, and the directions in which improvement might be looked for. As a result, we have the triple-expansion engines of the ocean greyhounds.

But all this work was far in advance of the thought of his time, and was destined to remain unappreciated for years after the author's death, which took place Aug. 24, 1832.

AMONG THE PUBLISHERS.

A TIMELY article on "A Tornado's Power," by William A. Eddy, in *Harper's Weekly* for July 26, gives a vivid description of the destructive tornado of July 13, near St. Paul, Minn. The article is accompanied by four illustrations.

— In an article in the August *Lippincott*, on "Milk-Legislation," R. M. Elfreth presents the European legislative methods for preserving the purity of this important article of diet, and suggests to our own legislators certain wise provisions. Charles Morris contributes a sketch of the Philadelphia Academy of Natural Sciences.

— Mr. Edward Atkinson is to publish in *The Popular Science Monthly* for August and September two extended and important articles on the revision of the tariff, under the title "Common Sense applied to the Tariff Question." Like other articles in the field of political science which appear in the monthly, these papers will discuss the subject with a refreshing disregard of partisan advantage. In the first of these, which will open the August number, he shows the incompetence of American legislators and government officers in dealing with financial questions, and, without taking extreme ground, goes on to point out weighty business considerations which should determine the direction of tariff reform.

— A dozen articles are included in the *Westminster Review* for July, issued in this country, by authority of the English publishers, by the Leonard Scott Publication Company, New York. A. Amy Bulley writes on "The Political Evolution of Women;" James W. Davis discusses the Sunday opening of public libraries, art-galleries, and museums; William Trant writes on "Prairie Philosophy," presenting a picture of social and daily life in the great Canadian North-west; Professor Andrew Gray writes on "Technical Education in Wales;" R. Seymour Long reviews the civil struggle in England in the seventeenth century, in a paper entitled "The Case for the Commonwealth;" E. F. Hannigan contributes an essay on "Genius and Moral Responsibility;" Janet E. Runtz Rees relates the experience of a bread-winner in an article on "Wage Value in America;" G. S. Godkin writes on "Old Italy *versus* Young Italy;" Theal's "History of South Africa," and some of the most important of recent novels, are reviewed; an anonymous writer discusses the rights of labor; and the usual monthly review of home affairs treats of the latest developments in English political life.

— Edward Marston, the veteran London publisher, writing in the August *Scribner* about "How Stanley wrote his Book," gives the following particulars of the materials from which it was made: "Mr. Stanley's memory of names, persons, and events, is quite marvellous, but in the compilation of his book he by no means trusted to his memory. His constant habit was to carry a small note-book, six by three inches, in his side-pocket. In this he pencilled notes constantly and at every resting-place. Of these note-books he has shown me six, of about one hundred pages each, closely packed with pencil memoranda. These notes, at times of longer leisure, were expanded into six larger volumes, of about two hundred pages each, of very minute and clear writing in ink. In addition to these field note-books and diaries, there are two large quarto volumes, filled from cover to cover with calculations of astronomical observations," etc. He also tells this story of Stanley while at work on his great book: "Sali, the black boy who travelled with him throughout his long and perilous expedition, is a youth of some resource. Until this terrible book had got into his master's brain, he had been accustomed to free access to him at all hours; but now things were different. Every time he approached the den, the least thing he expected was that the ink-stand would be thrown at his head. He no longer ventured therein. One day he originated a new way of saving his head: he had a telegram to deliver, so he ingeniously fixed it on the end of a long bamboo, and, getting the door just ajar, he poked it into the room, and bolted."

— A copiously illustrated account of the missions and mission Indians of California will be contributed to the August *Popular Science Monthly* by Henry W. Henshaw. He represents the rule of the priests as more conducive to the numerical growth of the Church and the profit of the missions than to the welfare of the Indians. A picture of Ramona and her children standing at the door of her hut is one of the illustrations. Mr. Bernard Hollander of London will contribute to the same number an illustrated paper on "Centres of Ideation in the Brain." It will show how the experiments of modern physiologists support some of the observations of the early phrenologists, though by no means indorsing all that the name "phrenology" implies. There will also be an article on "Ancient and Modern Ideas of Hell," by Frederik A. Fernald. It will doubtless prove very seasonable just now, when the air is full of the proposed revision of certain Presbyterian doctrines. Other articles are "Thunder-Storms," by Robert H. Scott; "A Queer Pet," by Miss E. W. Bellamy; and "The Uses of Animal Color," by Edward B. Poulton.

—The last two issues of the American Historical Association contain some papers of interest. The January number is partly occupied by the secretary's report and the list of members, which show the society to be in a flourishing condition, the number of members having increased, since the formation of the society six years ago, from forty to six hundred and twenty. The same number contains a paper by President Adams of Cornell, on "Recent Historical Work in the Colleges and Universities of Europe and America," which shows clearly, that, notwithstanding the improvements of the last few years, we are still in the rear of other nations in this department of study. It seems to us, however, that President Adams overrates the usefulness of the German seminary courses, which are mainly devoted to the mere study of facts; and that what we need are courses like those at Oxford and Cambridge, in which special attention is given to the formation of a true historical judgment as to the significance of events. The study of historical facts is very simple, as is proved by the ease with which young men learn it; but the formation of a judgment that can properly interpret history requires a far more elaborate culture, and ought, therefore, to be the chief object of attention. The April number of the association's papers is entirely devoted to a sketch of the origin of the national scientific and educational institutions of the United States, written by Dr. G. Brown Goode of the Smithsonian Institution. The author begins with an account of the formation of the American Philosophical Society at Philadelphia in 1769 and the American Academy of Arts and Sciences at Boston in 1780, both of which are still in existence. He then recounts the efforts of Washington, Joel Barlow, and others, to found a national university at the national capital,—efforts that have often been renewed since, though as yet without success. Special attention is given to the organization of the Coast and Geological Surveys, and some account is given of the earliest exploring expeditions. The foundation of the Smithsonian Institution is of course described, and particular attention is devoted to the organization and development of the weather service. Dr. Goode writes with an enthusiasm that makes his paper interesting, and we commend it especially to scientific readers. The papers of the association are published quarterly at one dollar each, by G. P. Putnam's Sons, New York.

— The American Academy of Political and Social Science was organized last December in Philadelphia, and now gives to the public the first number of its *Annals*. We wish we could say that the papers contained in it are superior to others on similar subjects that have appeared elsewhere; but they have the same superficiality that characterizes so much of American thought and scholarship. The best paper in the number is the opening one, by J. G. Bourinot, on "Canada and the United States." The author compares the government of his own country with ours, and, while admitting the superiority of ours on some points, shows

that we might copy some things from Canada with benefit to ourselves. In particular, he shows the advantages of a responsible ministry, which is the leader of legislation as well as of administration. Mr. Simon N. Patten has a curious paper on "Decay of Local Government in America," in which he contends that our State and local governments have "a mere nominal existence," which we take leave to say is absurd. The next article, by J. B. Clark, is on "The Law of Wages and Interest." It is based on Jevons's theory of final utility, but does not seem to us to shed any new light upon the problem. Mr. F. H. Giddings discusses the province of sociology, but fails to prove even the existence of such a science, or to state any of its principles. Following this paper are some tables by Leo S. Rowe, giving the courses of study in public law and economics in the German universities, and also an account by Jane J. Wetherell of a new kind of railway passenger tariff recently adopted in Hungary. It is impossible for us to describe it here, and its success is still problematical; but railroad managers will doubtless take an interest in reading about it. A variety of notes and book-reviews fill out the number. The *Annals* is published for the academy by A. L. Hummel of Philadelphia at one dollar a number.

—The July number of the *Nineteenth Century*, issued in this country, under authority of the English publishers, by the Leonard Scott Publication Company, New York, begins the twenty-eighth volume, and is a brilliant number. Sir J. Pope Hennessy opens it with a brief paper entitled "The African Bubble," in which he briefly discusses the relative positions of England and Africa on this important question engaging the attention of the world. Professor Huxley takes the new theological book, "Lux Mundi," as a text for the scientific interpretation of Scripture in an article entitled "Lux Mundi and Science." He directs his special attention to the story of the Flood, and his criticisms will doubtless have wide reading. T. W. Russell, M.P., writes on "Compensation or Confiscation," in which he takes up the subject of the political treatment of the temperance question in Parliament. Mlle. Blaze de Bury has an article on "The French Opera," in which she traces its history from its beginnings to the present time. The editor, Mr. Knowles, raises the question of memorials in Westminster Abbey, and explains, with the aid of two plans, how much room there is still unoccupied. The King of Sweden concludes his memoir of Charles XII., dealing with the later years of the hero's life. Henry Snow discusses one of the most important questions of the day in a paper on "The Increase of Cancer: its Probable Cause." An article on "Official Polytheism in China," by A. C. Lyall, treats of the official religion of China, and the extent to which it permeates official society. Frederick Greenwood, the late editor of the *Pall Mall Gazette*, and one of the foremost of English journalists, writes on "The Press and Government," and shows how intimate the connection between the two sometimes is. Oscar Wilde contributes the first part of a dialogue entitled "The True Function and Value of Criticism, with Some Remarks on the Importance of doing Nothing." Mr. Wilde expounds the nature of criticism as he understands it, in a thoroughly characteristic manner. Sergeant Arthur V. Palmer tells what he saw at Tel-el-Kebir, which is interesting as being the testimony of an eye-witness. Earl Grey discusses the Irish Purchase Bill. J. L. Mahon writes on "The Crisis in the Post-Office," treating of conditions which are not without importance in determining, in the future, the relations of trades-unions to government work.

—*The Chautauquan* for August presents, among other matter, "The Condition of American Agriculture," by Manly Miles, M.D.; "A Sixteenth Century Garden," by Ferdinand Cohn; "Country Life in Ireland," by J. P. Mahaffy, M.A.; "Keeping Well in Summer," by Felix L. Oswald, M.D.; "The Minor Lakes of the Northwest," by Horace B. Hudson; "Women Physicians in Germany," by A. Von Strande; "Economical Grocery Buying," by Christine Terhune Herrick; "Brain-Workers' Recreation in Flowers," by Sarah K. Bolton; "Out-door Life at Wellesley," by Louise Palmer Vincent; and "Children's Wit," by Margaret J. Preston.

Publications received at Editor's Office, June 30–July 19.

ABEL, Mrs. Mary Hinman. Practical Sanitary and Economic Cooking adapted to Persons of Moderate and Small Means. (Lomb Prize Essay.) Rochester, N.Y., Amer. Pub. Health Assoc. 190 p. 12°.

ANNALS of the American Academy of Political and Social Science Vol. I. No. 1. July, 1890. q. Philadelphia, A. L. Hummel. 164 p. 8°. $3 per year; with supplements, $5.

BAKER, A. L. Elliptic Functions. New York, Wiley. 118 p. 8°. $1.50.

BLACKMAR, F. W. The History of Federal and State Aid to Higher Education in the United States. Washington, Government. 343 p. 8°.

CHAMBERS, G. F. A Handbook of Descriptive and Practical Astronomy. III. The Starry Heavens. 4th ed. Oxford, Clarendon Pr. 384 p. 8°. (New York, Macmillan, $3.50.)

CHILDS, G. W. Recollections of General Grant. Philadelphia, Collins Printing House. 104 p. 48°.

CHISHOLM, G. G., and LEETE, C. H. Longmans' School Geography for North America. New York, Longmans, Green, & Co. 384 p. 12°. $1.25.

CLARK, W. G. History of Education in Alabama, 1702–1889. Washington, Government. 281 p. 8°.

DAVIS, E. W. An Introduction to the Logic of Algebra. New York, Wiley. 119 p. 8°. $1.50.

GURNEY, E. H. Reference Handbook for Readers, Students, and Teachers of English History. Boston, Ginn. 125 p. 12°. 85 cents.

HYDE, E. W. The Directional Calculus, based upon the Methods of Hermann Grassmann. Boston Ginn. 247 p. 8°. $2.15.

MYEROVITCH, M. The Origin of Polar Motion. Chicago, Rosenberg Bros., Pr. 32 p. 8°.

NEW JERSEY. Final Report of the State Geologist. 1889. Vol. II. Part I. Trenton, J. L. Murphy Publ. Co. 642 p. 8°.

PICKARD, J. L. School Supervision. New York, Appleton. 175 p. 12°. $1.

RAYMOND, M. G. Les Grands Centres d'Action de l'Atmosphère. Paris, Gauthier-Villars. 84 p. 12°.

TEXAS, First Annual Report of the Geological Survey of, 1889. Austin, State. 410 p. 4°.

U. S. GEOGRAPHICAL SURVEYS West of the One Hundredth Meridian. Vol. I. Geographical Report, 1889. Washington, Government. 780 p. 4°.

WELLS, E. R., jun., and KELLY, J. W. English-Eskimo and Eskimo-English Vocabularies. Washington, Government. 72 p. 8°.

—Chauncey M Depew has received an autograph letter from the Prince of Wales, acknowledging the receipt of his "Orations and After-Dinner Speeches," recently published by the Cassell Publishing Company, New York. The prince expresses his thanks warmly, and indicates his belief that a perusal of the book will assist him greatly in his work of preparing the numerous addresses he is called upon to deliver on ceremonial occasions.

—The fifty-eighth volume of the *Contemporary Review* begins with the July number, issued in this country, under authority of the English publishers, by the Leonard Scott Publication Company, New York. Mr. Bellamy opens the number with an article entitled "What Nationalism means," in which, while answering some of his most recent critics, he re-defines his position, and makes his theories clearer than he has done before. Gabriel Monod discusses recent events in France in a paper entitled "On French Affairs," in which he gives large space to the relations of France and Germany. Rev. Dr. Waugh contributes an exhaustive paper on "Child-Life Insurance," dealing with both the practical and theoretical parts of the question. Graham Sandberg has an important paper on "A Journey to the Capital of Thibet," based on the notes of the celebrated Hindoo scholar Chandra Das. This narrative is now made public for the first time, having been suppressed for political reasons. It tells of a part of the world never before described by a European. The article is accompanied with a sketch-map of the city of Lhasa, the capital of Thibet. Dr. Thomas Dolan writes on "M. Pasteur and Hydrophobia," devoting himself to an examination of the practical work of the famous Frenchman in this field. Sidney Webb contributes a thoughtful paper on "The Reform of the Poor Law," treating of the latest attempts to ameliorate the condition of the working-classes. Joseph Pennell, the well-known artist, tells of a new profession wanting professors, in a paper on "The Possibilities of Illustration." Professor John Rae continues the discussion of a betterment tax, which has lately been prominent in this review. The number closes with two brief papers on "Compensation for Licenses," — one by E. N. Buxton, and the other by Andrew Johnston.

—The forty-eighth volume of the new series of the *Fortnightly Review* begins with the July number, just issued by the Leonard Scott Publication Company, New York, under authority of the English publishers. It opens with a symposium on "The Actor-Managers," by Henry Arthur Jones and Herbert Beerbohm Tree. This subject has recently attracted much attention both here and abroad, and the present papers form an important contribution to the controversy. E. B. Lanin writes on "Russian Prisons: The Simple Truth," and draws a very dark picture of the realities of Russian prison-life. George Moore writes on "Meissonier and the Salon Julian," describing the origin of the Salon and the recent rupture between it and the artists. Edmund Gosse writes on "The Protection of American Literature," basing his paper on the late discussion in Congress on the copyright bill. J. Scott Keltie contributes a *résumé* of Mr. Stanley's expedition, dealing with its conduct and the results as viewed from a scientific standpoint. Madame James Darmesteter writes on "The Workmen of Paris." This paper, of which the first portion is now published, compares the condition of the Parisian workmen in the fourteenth and nineteenth centuries, and aims to portray a picture of actual life. John Addington Symonds presents some passages of Italian travel in an article entitled "Among the Euganean Hills." Three important papers on Germany and England in Africa, presenting as many phases of the subject, close the number. The writers are H. H. Johnston, V. Lovett Cameron, and Ernest W. Beckett. These papers are doubtless the most important contributions yet made to this subject, and are invaluable to those who would correctly understand the momentous events now transpiring in the Dark Continent.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—A Mining Engineer of standing and experience. One having had practical experience in Coal Mining and the manufacture of Coke preferred. Address A., care "SCIENCE."

CHEMIST.—A Harvard Graduate and Specialist in Chemistry desires a position with some manufacturing industry, or with a practical chemist. He would make an engagement to take charge of a laboratory and lecture on Chemistry. He has had large experience in the laboratory and school-room, and can give the best of references. Address J., Harvard College, Cambridge, Mass.

WANTED.—A Lady Teacher, at present teaching in England, with 12 years of very successful experience in primary work, desires a similar position in America. An appointment in the State of Ohio, or the City of New York, preferred. Excellent references, etc. Address in July or August, L. DUNCAN, Poste Restante, Stainland, Halifax, England.

WANTED.—The latest and most reliable authorities on the Occurrence, Analysis, and Practical Uses of Native Hydro-Carbons, such as Bitumen, Asphaltum, Mineral Wax, etc. Address DR. J. E. TALMAGE, Box 1,047, Salt Lake City, Utah.

WANTED.—A position as Teacher of Natural Sciences; will teach German or English branches if desired. Address Box 235, Charlestown, N. H.

A ZOOLOGIST, acquainted with the United States, graduate (Ph.D. Freiburg, B.Sc. of an English university) of many years' standing; late Fellow of an English college; late assistant to a German university, professor of Comp. Anatomy; many years a student at two German universities; pupil of Huxley, Kölliker, Semper, Wiedersheim and Weismann; author of many well-known memoirs on Comp. Anatomy and Embryology; thoroughly conversant with all branches of the subject; fond of teaching, with good testimonials, seeks a Professorship. Address "MORPHOLOGIST," Office of SCIENCE. Other information and a few testimonials can be seen at the Office of SCIENCE.

AN EXPERIENCED TEACHER desires to hear of a town in which he can establish a high school. Or, he will lease an academy. Address, G., Lock Box 19, Suffern, N. Y.

WANTED.—By a lady-graduate of Cornell University, position as teacher in high school, seminary or college; prepared to teach the following branches, employing, so far as is practicable, the laboratory method: Geology, Botany, Zoölogy, Physiology; also, if desired, Physics, Chemistry, Logic and Psychology. References to heads of above-named departments in Cornell University. JENNIE T. MARTIN, care Cornell University, Ithaca, N. Y.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I wish to exchange a fresh and complete set of Weiss and Spier's "Necropolis of Aucon" for other books, either new or second-hand, if the latter are in good condition. What have you to offer? Address Warren Watson, Kansas City, Mo.

1,000 botanical specimens representing 250 genera in exchange for those not in my collection. Send list of duplicates, and receive a similar one to choose from. Address E. E. Bogue, Orwell, Ashta Co., Ohio.

For exchange—14 volumes (1883-1889) American Journal of Science, 10 volumes (1880-1889) American Naturalist, 21 volumes (1879-1890) English Mechanic, all in good condition for binding; also, Morris Typewriter. Wants first-class microscope, camera, chemical or physical apparatus. Address, with full particulars, E. R. Chadbourn, Lewiston, Maine.

Wanted.—To exchange land and fresh-water mollusca, (principally *Helices Achatinellae*, Clausiliae and Limnaeae,) for those not in my collection. Lists exchanged. Address E. H. White, Box 200, Astoria, Or.

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted—To furnish roots of *Dodecatheon Meadia*, *Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
VOL. XVI. No. 391.

NEW YORK, AUGUST 1, 1890.

SINGLE COPIES, TEN CENTS.
$3.50 PER YEAR, IN ADVANCE.

A SLOW-SPEED ELECTRIC MOTOR.

A NEW automatic low-speed electric motor, designed by Frank A. Perret, electrician of the Elektron Manufacturing Company of Brooklyn, is shown in the accompanying illustrations, Fig. 1 being an end view, and Fig. 2 a section showing the magnetic circuit. It is of the multipolar type, and is designed to run at from 500 to 600 revolutions per minute. For special work the armature may be wound for a speed of 350 revolutions. While the speed is comparatively low, the machine is not heavy, as is the case of many motors designed for slow speed for special work.

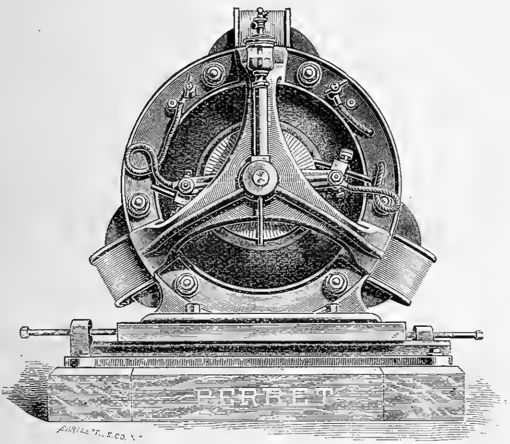
The practical advantages of low-speed motors are many. In ordinary machine-shops, wood-working shops, and printing-offices, for example, the shafting is commonly run at from 200 to 300 revolutions per minute; and it is a simple matter to belt directly to it from a motor running at 500 or 600 revolutions, thus dispensing with extra shafting and belting. These motors have recently been applied by direct gearing to pumps and to coal-cutting machines in mines, and also to the operation of coal-cutting machines by means of rope transmission from the motor to the cutter. Their slow speed also makes them well fitted for the direct driving of large exhaust fans and blowers, and for operating hoists and travelling cranes. In addition to the advantages of low speed in the special cases mentioned, there is, of course, a general advantage in the avoidance of the rapid wear and deterioration often connected with high speed.

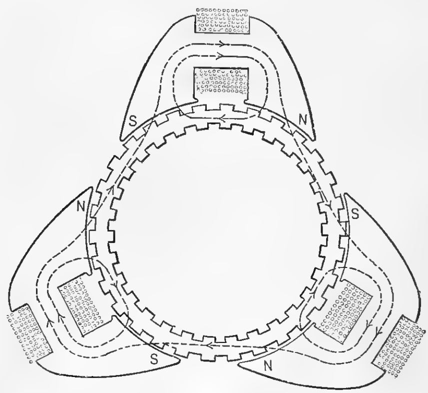
These motors are built with a 6-pole field, and with armatures of large diameter. A powerful torque and great momentum of armature are secured, which are decided advantages when a heavy load is thrown suddenly on, as is often the case in elevator-work and hoisting.

These larger motors retain the distinctive feature of laminated field-magnets which were characteristic of the smaller Perret machines, as, it is claimed, the results secured would be practically impossible with any other construction. The armature is a ring of comparatively large diameter, with longitudinal channels on its periphery, in which the conductors are wound. They are thus embedded in the iron, which is in such close proximity to the iron pole-pieces that there is practically no gap in the magnetic circuit.

The field consists of three separate magnets, arranged at equal distances around the armature, each magnet having two pole-pieces, the winding being such as to produce alternate north and south poles. The magnets are built up of plates of soft charcoal iron, which are shaped as shown in the diagram, the magnet thus produced being readily wound in a lathe. A non-magnetic bolt passes through a hole in each pole-piece, and the plates are clamped together between washers and nuts. The bolts also serve to attach the magnets to the two iron end frames, which are of ring-shape, and are bolted to the bed-plates of the machine. The magnetic circuit is of unusually low resistance, by reason of its shape, its shortness, which is shown by the diagram, and the superior quality of iron used.

There is, it is claimed, no loss of magnetism in the frame or in the shaft of the machine, as the magnets are supported at some distance from the former by means of the non-magnetic bolts, and the armature is mounted on the shaft by spiders of non-magnetic metal. The whole machine is enclosed by a shield or case of sheet





FIGS. 1 AND 2.—PERRET MULTIPOLAR ELECTRIC MOTOR.

metal, as shown in Fig. 3, which is a perspective view of a motor, with sliding base and starting-box complete.

These machines are calculated to be equally efficient as dynamos, and are coming into use in many small isolated incandescent-light plants. For this purpose they are compound wound; and the regulation, it is claimed, is so perfect, that all but one lamp may be suddenly turned off without moving rheostat or brushes, and without noticeable change in the brilliancy of the remaining lamp.

THE LOUISVILLE TORNADO.

ONCE in a great while the whole world is startled by such an appalling catastrophe as the Chicago fire of 1871 or the Boston conflagration of 1872. Such disasters are entirely outside of the usual experience, and thus make a most profound impression. Of such a character are to be regarded the Grinnell (Iowa) tornado of April 17, 1882, and the more recent one at Louisville on March 27, 1890, in which 76 people were killed and $2,250,000 of property were destroyed. It might be thought that every tornado has exactly the same power, but does not show it because it does not happen to strike where it can do the most damage. To a certain extent we might argue in precisely the same way about a fire. Every fire, under such environments as mentioned above, would reproduce the terrible effects, but we find that the ordinary result of a fire is far different; and this is exactly the truth in regard to tornadoes. No two tornadoes are alike in their diameter or force. We may argue, however, that if two thousand tornadoes have produced one such as that at Grinnell, then we need not expect such a one again in about the same number, excepting as an increase in the size and frequency of towns in the tornado regions gives a more frequent opportunity for such accidents. This may also be said as true regarding the most serious fires.

Just preceding this tornado the atmospheric disturbance to the west and north-west of its development was unusually marked; so much so, that all the region in which the violent storms occurred were warned of their probable occurrence nearly twelve hours in advance by the Signal Office at Washington. The centre of the general storm at 7 A.M. (Central time), or twelve hours before the tornado, was in eastern Kansas, at which point the air-pressure was below 29.1 inches. At 7 P.M. this storm had moved rapidly to central Illinois, and just fifty-seven minutes later Louisville was struck and partly destroyed. This fact, that we have a chart of the meteorological conditions within an hour of this outburst, is very important. We find that the winds throughout the tornado region were from the south and south-east; and this current existed even up to the clouds, as we have determined in so many cases before. In fact, the whole circulation of the atmosphere was no whit different from that noted again and again in such general storms. The tornadoes were suddenly thrown into this atmospheric circulation almost without warning. The velocity of the general storm, moving nearly due east, was 38 miles per hour from 7 to 11 A.M. of March 27, 39 miles per hour in the next four hours, and 37 miles per hour in the four hours just

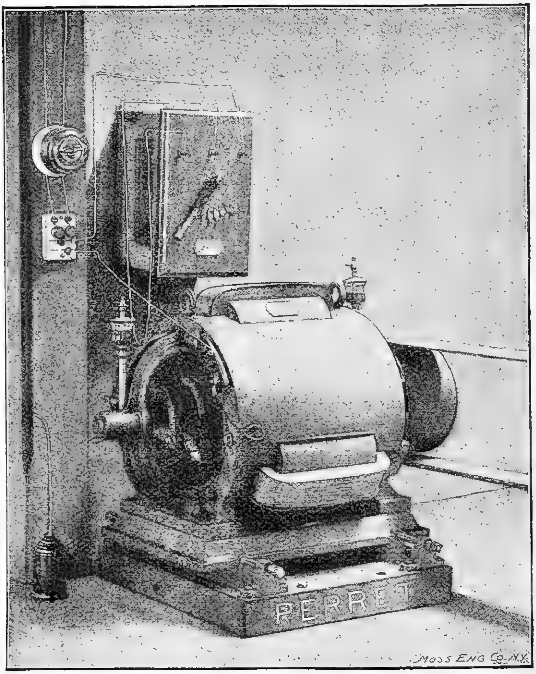


FIG. 3.—THE PERRET MULTIPOLAR ELECTRIC MOTOR.

preceding the tornadoes. It is a little difficult to obtain the exact velocity of the tornadoes, as the times are in most cases very indefinite; but the best authenticated times in the Louisville outburst would make it a little more than 80 miles per hour, the path being directed nearly north-east. There was a most remarkable series of tornadoes in this region, including southern Illinois and Indiana, western Kentucky, and just the northern border of Tennessee. The paths were all in a north-east direction, the earlier being 200 miles nearer the centre of the general storm, and much shorter than the later.

The first definite notice of a violent rush of air was at Mill Creek, Ill., at 4.30 P.M. This track (I) was very short, and is not traced outside of the town. Track II runs a short distance near Olney, Ill., and the time was 5.30 P.M. Track III was much the longest, and most destructive of all. It was first noted at 5.30 P.M., at Metropolis, Ill., and passed through or near the following towns (all in Kentucky), dipping now and then as it rushed onward at 80 miles per hour,— Hampton at 5.40; Marion at 6; Clay at 6; Dixon, Sebree, West Louisville, Delaware, Owensboro, at 6.17; Enterprise, Knottsville, Hawesville, Louisville, at 7.57,— and is last heard of in Jeffersonville, Ind., just across the river from Louisville. Track IV first appears at Farmington, Ky., and passes near Kuttawa, Eddyville at 6.30, Bremen, and Hartford, all in Kentucky. Track V is traced near Belleview, Caledonia, and Sinking Fork, in Kentucky. Track VI may possibly be connected with III, and is traceable near Eminence, Pleasureville at 8.30, La Grange at 8.50, Campbellburg, and Carrollton, all in Kentucky. Track VII passes near Rogana, Tenn., at 8.30; Eulia, Tenn.; Coatstown, Tenn., at 8.50; Dixon's Springs, Tenn. (probably); Butlersville, Ky.; and Glasgow, Ky., at 9. Track VIII is traced near Fayetteville, Fosterville at 9.15, Millersburg at 9.15, all in Tennessee. Track IX is near Rockcastle Springs, Ky., at 11. The last violent wind, or track X, is found at Marshall, Ky., at 8.30.

It will be understood, that, though all this region felt these violent wind-rushes, yet these paths are by no means continuous from town to town, and in most cases there was no serious damage. Louisville suffered the worst, as just noted. Outside of Louisville there were 59 killed and a property loss of $1,000,000. At Metropolis, Ill., 1 person was killed, 50 injured, and the property loss was $150,000. The most exaggerated reports of losses were circulated by the newspapers. One prominent Western paper, whose statement was widely copied by others, a whole month afterward placed the loss in Webster County, Ky., alone at 111, while the true loss was 8. In Barren County the loss was placed at 30, though no one was killed there. In Lyons County 23 killed were given, though but 2 died there. This same paper made no mention of loss of life in Livingston County, where 9 were killed, and in 6 other counties where an aggregate of 40 were killed. Of course, there was no intention of distorting facts in this case: it is given as a simple illustration of the great difficulty which inheres in studies of this kind, and the great danger there is in taking descriptions by two or more observers of the same destruction, and applying them to several places, and not to a single spot. The utmost care should be exercised in giving the exact place of the catastrophe, either as in a town or village, or so many miles in any direction, as the case may be.

While the names of a large number of towns have been given above as visited on this date, yet there were many others that could not be enumerated for lack of space: in fact, a thorough research would seek to establish exactly the spots where destruction was least, as well as where it was greatest. It is quite remarkable that though this whole region was in a disturbed condition, meteorologically speaking, yet there were enormous areas not seriously touched. A careful research would have developed some valuable facts; but, so far as known, the only outburst given a careful study was at Louisville. It is to be deplored that such a fine opportunity to add to our knowledge of these storms was lost. We may hope that in the near future such occasions will be seized upon as of the greatest importance. It is probable that the weather service of each State would be best suited to take up this study, and it is noted that the Ohio Weather Service has exhibited commendable zeal in this regard.

There has been published in the *Weather Review* a good description by Sergeant Frank Burke of the tornado at Louisville, Ky., and this will be freely quoted from. The times given are all reduced to Central. "At 7.30 P.M., although intense darkness precluded careful observation, the clouds in the south-west exhibited evidence of a most violent commotion. It appeared as though north-west and south-west clouds, in coming into contact, had been shattered to pieces, and their fragments, intermingling, had been thrown upward and laterally by the force of the shock. These movements occurred at a considerable elevation, the space between the clouds and the earth having a misty or fog-like condition. Heavy rain began almost at the moment of this commotion. At the same time the lightning-flashes, which had occurred hitherto only at long intervals, increased tenfold in frequency and intensity, the south-west quarter of the heavens being the centre from which the almost incessant flashes radiated. A peculiar feature of this display was the almost entire absence of thunder. The wind had been blowing a moderate breeze from the south-east during the afternoon. At 7.34 it shifted suddenly to the south-west, and increased in force. At 7.50 the rain had almost ceased. A few moments later, scattering hail fell, average diameter half an inch; then came a momentary lull in the wind, and a peculiar, indescribable oppressiveness of the atmosphere. The darkness was intensified at this moment by the sudden diminution of the gas-jets, which in many cases were extinguished. It may be important to state in this connection that the lights were not blown out, but failed through lack of pressure in the reservoir. The approach of the tornado was heralded by a tremendous roaring sound, mingled with the crash of falling buildings. The noise has been likened to that produced by the passage of a heavy train of cars over a bridge, a thousand times intensified. The storm struck the city at 18th Street and Broadway, crossed it in an almost due north-east direction, and at 7.57 left it at 7th and Water Streets. This time is verified by the telegraph officials, who noted it as the moment when their wires, which cross the tornado's track, ceased to work. Persons who saw the cloud coincide in stating that it was of a balloon or turnip shape, though the darkness and confusion precluded accurate observations of its movements. It was accompanied by a most terrific electric display, and several reliable persons assert

that balls of fire were playing about it. The highest wind recorded at the Signal Office, less than 1,800 feet from the path, was 36 miles per hour. After it had passed, the wind shifted suddenly to the west, and continued to blow from that point for twenty-four hours, and with increasing velocity, the record showing 42 miles per hour at 9 P.M. The sky was perfectly clear at 9.30 P.M., except a streak of very high and apparently motionless cirrus in the west. Shortly after this time the atmosphere became obscured by a peculiar haze or smoke, through which the moon shone with a reddish light.

"Where the tornado entered the city, the width of the path was a little more than 600 feet. As the cloud progressed, the width of its path increased to 1,500. There is no evidence that the tornado-cloud touched the ground at any point in Louisville. In nearly every case the destruction was confined to the upper floors of the demolished buildings, but comparatively few houses being totally ruined; and also a large proportion of the one-story structures in its path were uninjured. Churches, halls, warehouses, and other structures having but little interior support, suffered the most. To this fact is attributed the principal loss of life. At the Falls City Hall alone, where a large number had congregated, 44 were killed. Frame buildings invariably withstood the shock much better than those constructed of masonry. But few of the destroyed buildings bear evidence of being actually blown down by the whirl of the tornado-cloud itself, but their destruction was apparently caused rather by a lateral or vertical rush of air-currents centring toward it. The ruins and the disposition of the *débris* give ample evidence of this. The right [south] side of the storm-track, and in a less marked degree the left side, afforded numerous examples of the intensity of this lateral force. In both cases [i.e., on either side of the track] the sides of the buildings facing the storm were pulled out, the *débris* falling towards it [the track]. In many cases fragile articles, such as glassware, remained undisturbed. In the centre of the track the destruction was mainly due to a vertical force which lifted the roofs of the buildings. The roof of the Union Depot was lifted bodily, and deposited intact on the floor, immediately beneath its original location.

"The destroyed buildings were, as a rule, of a very unsubstantial character, being mainly ordinary brick dwellings, small stores, and warehouses. The Fort Nelson building, at 7th and Main Streets, is the most notable exception to the general destruction in the tornado path. This is a well-constructed six-story building, and, by its greater height than those surrounding it, was more exposed to the storm's fury. Despite the fact that it was directly in the storm's track, and that all other houses on either side were wrecked, it escaped with the loss of its windows. The gyratory motion of the tornado is well illustrated in the disposition of the prostrated trees in the parks, and the timber outside the city. In the centre the trees were piled in promiscuous heaps, denoting a tremendous wrenching or twisting force. On the right side the tree-tops point almost north-east; those on the left side, nearer due east. Throughout the path of the storm the zone of destruction on the right [south] side is more than twice as wide as that on the left side, and shows a much greater intensity of force."

I have quoted almost the whole of Mr. Burke's most excellent report, which may be regarded as a model in its terseness and statement of valuable facts. One or two comments are added. The heavy rain preceding the tornado seems to have been independent of it, and not necessarily due to any action in it. The presence of lightning, and absence of thunder, are noteworthy, and may explain the fact that oftentimes no electric action is reported in a tornado. Thunder is always regarded as the most prominent characteristic in a thunder-storm. The sudden shifting of the wind to a direction from the tornado is very significant. How could this have been if there were a partial vacuum in the storm? The failure of the gaslights is very interesting, and at first sight appears to show a marked diminution in pressure. Diligent inquiry at a gas-office, however, shows that no reasonable diminution in the pressure of the atmosphere could affect a gaslight; moreover, this same phenomenon was noted at Cleveland, O, at a time when there was a very high wind, but no tornado. Investigation has shown that a high wind forces the immense gas-holder against the vertical posts, and this causes the failure in the pressure. This explanation is now accepted by those familiar with the subject. It seems also probable that such a high wind, when blowing near the earth, would have a tendency to an upward thrust; and this has been shown repeatedly by the uplift of dust, leaves, and small branches in front of a sudden gust. The increasing wind after the tornado was not connected in any way with that, but was simply the high wind in the rear of a storm, and in this case it was intensified by the steep barometric gradient. The preservation of the Fort Nelson building was probably due to a diminution in, or a lifting-up of, the storm just at that point, and not to its construction. There are innumerable instances in which the frailest structures have been left undisturbed in the centre of a tornado-track. The evidence from the prostrated trees does not bear out the gyratory theory, but is rather strongly against it. If there were any gyration, say, from right to left, the trees on the left (north) side ought to face west, and not east as they were reported.

Mr. Burke, in a private correspondence, states that he made a most diligent search for evidence of corks being blown from bottles, but did not find a single case, although there were several apothecary-shops and bottling-establishments in the centre of the track. He also states that the diminution in the gaslights was quite sudden, and passed away quickly. It would be interesting if some one would determine the velocity of the wind needed to produce this effect. This report must be regarded as corroborative, and not as absolutely establishing points now in doubt. The statements in the report show only very slight evidence of bias or leaning toward any theory; and this is just what is needed now, if we are to make any headway in our studies. The report is worthy of commendation.

Incidentally one of the more interesting facts brought out by the tornadoes on this date are barograph traces made by the passage of the tornado at Owensboro, Ky., and Cincinnati, O. These are given in the accompanying plate, Figs. 6 and 7. Unfortunately the original trace for Fig. 6 was carried by the owner to Scotland, and given to Mr. Buchan, who rightly regarded it as a most valuable acquisition. It is to be regretted that the original was not kept in this country, where it belongs, and a copy taken abroad. The copy

I have, however, is a fair representation of the original. I have enlarged Figs. 5, 6, and 7 from the Richard barograph to make them directly comparable with the barograph sheet at Washington, given in Fig. 8. The barograph at Owensboro was a mile and a half from the nearest point of the tornado. It has been supposed all along that a tornado could not produce any effect on pressure more than a few hundred feet from its centre, but here seems to be good evidence of an effect over 7,000 feet away. The first sudden drop of the curve with an immediate return is a little singular, and appears like the sudden drop found by others, and explained by the effect of the wind. Whatever may have caused this drop, there is no doubt of the rise after it;

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

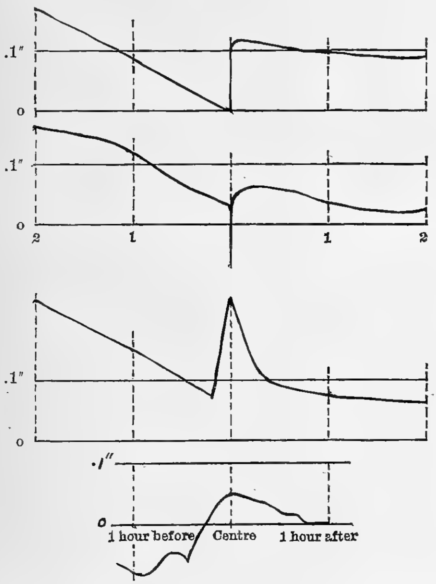


Fig. 5, tornado St. Louis, Mo. (Jan. 12, 1890, 5.16 P.M.); Fig. 6, tornado Owensboro, Ky. (March 27, 1890, 6.17 P.M.); Fig. 7, tornado Cincinnati, O. (March 27, 1890, 8.20 P.M.); Fig. 8, thunder-storm Washington, D.C. (June 22, 1890, 9.8 P.M.).

and this rise is far more striking at Cincinnati, where the storm crossed 59 minutes after leaving Louisville. Fig. 5 is also given from the barograph at St. Louis during the tornado of Jan. 12 of this year. This has already been referred to. There is no doubt of a marked rise here. Fig. 8 is a portion of the pressure-curve made at Washington, D.C., during the prevalence of one of the most severe thunder-storms that has visited the station. There was a steady rise for an hour, and a less rapid fall after the centre had passed. This storm came up and passed off very slowly, and was attended by most brilliant lightning and a terrific wind. The general similarity in these curves, excepting Fig. 6, is very striking. We may hope to get more of such curves on both sides, and possibly in the centre of tornado-tracks.

Instructions for Observing Tornadoes.

If any one thing has been emphasized in these pages, it has been the extreme need of more light on this whole question. The earlier investigators of the phenomenon were untrammelled, to a large extent, by preconceived opinions, and it must strike every one that few substantial facts unknown to them have been brought out since their time. It is to be hoped that the number of those willing to aid in establishing the facts and ferreting out the mysteries will be largely increased, and it is for such these instructions are given.

1. It is very essential that one divests himself of every preconceived notion about the whirling, sucking, or any other action of a tornado. There is the utmost danger of seeing the tornado do what we think it ought to do. It would be far safer, if one has an inclination to such views, to deny that such a view is correct, and only to accept it after most incontestable proof.

2. Note the time of day carefully, and specify whether the time used is Eastern, Central, Mountain, or some city time.

3. The side of the track on which the observer stood should be given.

4. Note the appearance of the clouds in the distance,—whether they roll upward, come together from the north and south,—or any other phenomenon connected with them.

5. Special note should be made of a cloud of dust and its general appearance.

6. See whether the funnel-cloud is visible at a distance, or suddenly breaks into view on the approach of the tornado. If possible, locate the first appearance of the funnel by a tree, house, or object close by, and, after the tornado has passed, measure the distance from the observer's position to that of the tornado when first seen.

7. If the observer is a thousand feet or more away from the funnel, or cannot see distinctly trees or objects in it or near it, he should not try to make detailed observations of the whirl, or any thing else at the tornado. Fix the attention on the motion of detached clouds. Make every effort, by comparison with trees and houses between the tornado and the observer, to get its height, width, and speed: these can be much better found out at a little distance than close to the cloud.

8. Make careful observations of all electric displays, the appearance of balls of fire, the sound of thunder, the roar of the tornado, etc.

9. If the observer is within a hundred feet of the tornado on the north side, he need have no fear, and may carefully examine all objects flying just above the ground. He should note carefully the foot, the middle, and the top of the funnel, to see whether any tree or object is carried to his right as he faces the funnel.

10. Note also whether any object is carried up straight in the funnel, or whether it is borne along in the swift wind. If there is an uprush in the tornado, it ought to be easily told; and the appearance will be very different from that if the object or house is borne along by the wind, and afterward inclined upward. If there is a sort of explosive effect, the upward motion will be more or less jerky, and not steady as in a stream. On the whole, the evidence seems to show something like an uprush, though it seems conclusive that this is not due to a vacuum in the tornado, as many think. It is very plain that nothing can be sucked into the tornado, because of a partial vacuum there; but if it rushes in or up, it must be borne or propelled by a stream of electricity, so to speak, or by a rush of air. One of the best illustrations of

this has just come to hand from the storm at Bradshaw, Neb. This tornado passed over a tank ten feet long, three feet wide, and twenty inches deep, full of water. This tank was air-tight, and had an opening in the top one foot square. The observer reports that the tornado sucked all the water out of this tank. A moment's reflection will show that this could have been done only by the insertion of the funnel into the opening one foot square. Of course this is absurd, and we must resort to some other explanation of the phenomenon.

11. After the tornado has passed, note the appearance of the houses for explosive effects.

12. Pay particular attention to the direction of the trees, making a separate observation on the south side, in the centre, and on the north side. See if any *débris* or objects have been carried in any case toward the west or south-west on the north side of the track, and measure the distance.

13. A note should be made of the width of the greatest destruction, not including houses unroofed on the borders; also the length of the path where it was most destructive, and the distance from the point at which it first struck the earth to the point at which it left the earth during the time of the greatest destruction.

14. Give the names of persons killed, if any.

15. Give an estimate of the loss to buildings, also specifying the number of buildings destroyed and their characters as to strength, etc.

16. A note should be made of the rainfall,— whether it was most abundant before, during, or after the tornado; also, if possible, the amount of rain at the centre of the track and at some point two thousand or three thousand feet on either side.

17. Careful note should be made of hail, size of stones, width of track, situation with respect to the main track, etc.

18. After the tornado the direction of the path should be most carefully determined.

19. All evidences of corks flying from bottles should be carefully looked for.

20. If one has a barograph, its record will be of the utmost value. If one has a barometer, an observation should be made by some one every minute till the tornado has passed. If the barometer is an aneroid, the face should be gently tapped before each observation. A steady watch of the needle may show any sudden fluctuation too rapid to be caught by reading the barometer. This instrument may be read in a dug-out or a cellar as well as in a house.

Of course, every one will keep eyes and ears open for any and all phenomena to be noted in this remarkable outburst.

H. A. HAZEN.

NOTES AND NEWS.

IN *Science* of July 25, second column, 36th line from the bottom, "*cenoreus*" should read "*cinereus*."

— A census taken in St. Petersburg in December, 1889, proved that during the previous twelve months the number of inhabitants had increased by 25,006, and had attained to a total of 1,003,315, says *The Scottish Geographical Magazine*. Attention is drawn to three noteworthy points regarding the population: the first is that the increase is greater in the suburbs than in the heart of the city; in the second place, the ratio of women to men has increased during the last twenty years, probably in consequence of a greater demand for female labor; lastly, since 1885 the births have been more numerous than the deaths, by 2,750 yearly.

— Some discussion has been going on in Ceylon over the question of the language spoken by the Veddahs, the aborigines of that country. The subject, says the *Colonies and India*, would seem to be one well worthy the attention of philologists; and the brothers Sarasin, who have been pursuing their anthropological researches in Ceylon, express the opinion, that, if a philologist were to take the matter up, great service would be rendered to all those engaged in the work of scientific research in the island. Tennant says of the Veddahs (*Nature*, July 17), "Their language, which is limited to a very few words, is a dialect of Singhalese without any admixture from the Sanscrit or Pali, — a circumstance indicative of their repugnance to intercourse with strangers." Professor Schmidt of the Leipzig University, who visited the Veddahs last year, says, "Their language is similar in construction to the Dravidian languages, — that is, similar in grammatical construction,— but they have adopted a great number of Singhalese words," which enabled him to hold converse with them by means of a Singhalese interpreter. The Drs. Sarasin also managed to make themselves understood by means of Singhalese.

— A recent exhibition of electrically deposited copper in London, England, attracted much attention from persons interested in the use of that metal, particularly for steam-pipes and electric conductors There were shown copper pipes of all sizes, from 6 inches to 18 inches in diameter by about 10 feet in length, and ranging from one-sixteenth to three-eighths of an inch in thickness. They were prepared by an electrical copper-depositing process, on a commercial scale, from common Chili bars without any intermediate process. The bars are placed as the anode in an electrolytic bath, and the tubes are deposited direct on a rotating mandrel, each individual atom of metal being rubbed into those surrounding it by an agate burnisher. The result is a metal having a tensile strength of 25 tons per square inch, with 20 per cent elongation, and of such purity that when drawn into wire it has an electrical conductivity of 104, or 4 per cent better than the standard. This metal is so ductile that it can be drawn down, without any annealing whatever, till it takes forty miles to weigh a pound.

— The Engle garbage-cremator, which has been illustrated and described in these columns, is being successfully introduced in various parts of the country, especially in the South. In Tampa, Fla., one has been constructed of a capacity sufficient to dispose of that city's refuse. An official test, made previous to formal acceptance of the cremator by the authorities, was described in a recent issue of the Tampa *Tribune*. According to that paper, an accurate account kept, showed that in about seven hours' actual running time the furnace destroyed twenty cubic yards of night-soil and garbage, much of the latter being completely saturated with water, and containing large quantities of melons and melon-rinds. The fuel used was light wood, of which about one-quarter of a cord was burned, and three-quarters of a cord of slabs and waste refuse lumber. As nearly as can be stated, the operation of the furnace showed that it would destroy at least forty cubic yards of material in twelve hours, and would require about three-quarters of a cord of light wood during that time. The furnace has been formally accepted and paid for by the city, and will at once be put into active use.

— The council of the Scottish Meteorological Society refer, in a report made July 14, to the observations of Mr. Rankin on the number of dust-particles in the atmosphere, carried on with two sets of apparatus invented by Mr. Aitken. *Nature* states that, though it would be premature to offer a statement of positive results, the council think that some interesting conclusions appear to be indicated by the observations. The maximum number of dust-particles in a cubic centimetre hitherto observed is 12,862, on March 31; and the minimum, 50, on June 15. On March 31, at 4 30 P.M., the summit was clear, and the number of particles was 2,785; but shortly thereafter a thickness was seen approaching from south-west, which by 6 P.M. reached the observatory, and the number of particles rose to 12,862. On June 15 many observations were made during the day, when the number of particles fell from 937 at midnight, to 50 at 10.30 and 11.42 A.M. The observations point to a daily maximum during the afternoon

minimum barometer, and a minimum during the morning minimum barometer, these being probably intimately connected with the diurnal ascending and descending currents of the atmosphere. Interesting intimate relations are also indicated between the numbers of dust-particles and the cyclones and anticyclones over north-western Europe at the time. The observations also indicate that the dust-particles may vary enormously during the presence of mist or fog, without being accompanied by any difference in the apparent density of the fog. The council consider that the inquiry is an extremely hopeful one; and, in view of the relations with cyclones and anticyclones, its bearings as regards the forecasts of the weather will be very specially investigated.

— For several years past it has been the practice of the Indian Meteorological Department to issue in the month of June a forecast of the prospects of the monsoon rains, based partly on the reported extent and thickness of the Himalayan snows, partly on the distribution of the atmospheric pressure, the small variations of which are found by experience to be remarkably persistent in India, and to serve as an indication of the probable strength of the monsoon, and alternately of the prevalence of dry land winds. The forecast for the forthcoming season announces, according to *Nature* of July 17, that owing to the very slight snowfall of Afghanistan, Baluchistan, and almost the whole of the Himalayan region, the conditions are eminently favorable for a good strong monsoon. The only unfavorable indication is that the winter of 1889 has been very severe in Yarkand, and perhaps in other distant parts of central Asia. The pressure is unusually low this year in Bengal, and above the average in central India and the northern half of Bombay; and the local pressure conditions considerably resemble those of 1876. It is therefore considered probable, that while the eastern half of the Ganges valley, Assam, and Burmah will receive early and abundant rain, the rains may be late and scanty over a considerable area of north-western India.

— Recently Mr. S. F. Menage of Minneapolis very liberally agreed to fit out a scientific expedition to the Philippine Islands. Messrs. D. C. Worcester and F. S. Bournes of the University of Michigan were willing to go, and on July 22 they left Minneapolis for Vancouver's Island, *en route* to Manila. They purpose remaining in the Archipelago for at least two years, and during that time they will prosecute the work of zoölogical and botanical collecting under the most favorable auspices. While specializing upon birds and corals, they will not limit themselves to these, but intend to make collections of *Entomostraca*, fungi, fresh-water *Algæ*, *Mammalia*, and flowering plants. They will give some special attention, moreover, to the land-shells of the islands, many of which present most curious problems of descent and distribution. The large collections which will be made, if no unforeseen accidents occur, are to be worked over under the auspices of the Minnesota Academy of Sciences, and will be deposited in its museums for the use of scientific men. Both Mr. Worcester and Mr. Bournes are experienced zoölogists, and Mr. Worcester was for some time instructor of botany in the University of Michigan: so they are well qualified to undertake the study of so diverse and little known a fauna and flora as that of the Philippine Islands. The thanks of American botanists and zoölogists are due Mr. S. F. Menage, who so generously endowed the expedition. From it results of real scientific value may be confidently expected.

— That the latitude of a place is not constant has long been suspected; but it was only at the end of last year that systematic observations, carried out at some of the observatories of central Europe, clearly established the fact by eliminating all chances of error in instruments and observers. Professor Helmert reported in No. 2,963 of the *Astronomische Nachrichten* that the latitudes of Berlin and Potsdam, which had shown no perceptible variation during the first six months of 1889, in the third quarter of that year increased at first, and then diminished, the movement continuing till January, 1890. In Berlin and Potsdam this decrease amounted to from five to six inches, and this variation was confirmed by observations at Prague and Strasbourg, the results at the first three observatories agreeing to within one-tenth of a second. According to *The Scottish Geographical Magazine*, the subject is to be discussed at the meeting of the Commission for International Geodesy, to be held in Freiburg next September, when, it is to be hoped, arrangements will be made for a strict examination of this phenomenon.

— The population of Iceland has for several years been decreasing, owing to the strong tide of emigration to America. It is stated in *The Scottish Geographical Magazine* that the population in 1888 was 69,224, whereas in the preceding year it amounted to 69,641, and in 1885 to 71,613. This phenomenon is most marked in the northern and eastern parts of the island. The growth of the population of Reykjavik, the capital, from 3,460 in 1885 to 3,599 in 1888, shows that the tendency of population to concentration in towns prevails also in Iceland.

— Many of the workmen who were employed in the caissons of the East River, Forth, and other bridges, suffered severely from the effects of working in an atmosphere of compressed air, as do those now employed in the tunnel under the Hudson River. During the construction of the Forth Bridge piers, it was noticed that the sufferers were in the habit of spending their Sundays and Saturday half-holidays in the air-chamber, thereby finding relief from their pain. Acting on the idea suggested by this fact, Mr. Moir, the engineer in charge of the Hudson River Tunnel, has had constructed a compressed-air hospital for the men employed in the tunnel, among whom there have been several severe cases of "bends," although the air-pressure is not particularly high; never, indeed, exceeding thirty pounds per square inch. The hospital, as described in *Engineering*, is a cylinder 18 feet long by 6 feet in diameter, constructed of steel plates three-eighths of an inch and half an inch thick, and divided into two chambers by a transverse bulkhead. One of these chambers acts as an air-lock for the other, and both are fitted up with beds and every thing necessary for the comfort of the patients. The air-pressure is maintained by a pump, a constant supply of fresh air being secured by keeping a pet-cock in the shell of the hospital open, through which the air continually leaks out. A safety-valve is also supplied to prevent over-pressure, should the pumps run away.

— A long article by Dr. von Danckelman, containing details concerning the atmospheric phenomena of the Guinea coast, is thus summed up in *The Scottish Geographical Magazine* for July: "These depend in the main on the atmospheric pressure over the lands of North Africa, and especially the Sahara, where the mean temperature in summer rises above 98° F. The low pressure thus produced draws in the air from all sides to restore equilibrium. Hence the prevalent winds on the Guinea coast during this season are the south and south-west; while in winter the contrary phenomenon occurs, except sometimes on the shore, where the higher temperature of the land maintains a continuance of southerly breezes. The highest pressure occurs in July and August, and the lowest in February and March. The range of the monthly mean is small, amounting only to from .14 to .18 of an inch. As regards temperature, it is found that the maximum occurs in February and April, and the minimum in July or August. The mean daily range is nearly twice as great in the hottest season as in the coldest, and increases considerably towards the interior. In Bismarckburg the mean maximum (in March) was 87.7° F., and the minimum (in July and August) 65.3°, and the maximum and minimum ranges 23.6° and 13.8° respectively. At Akassa the average daily range is only 10°, while at Bismarckburg it is 18.5°. Turning now to the rainfall, it appears that a rainy season of four months sets in shortly before the sun reaches the zenith, which it does in the beginning of April, and that the maximum fall occurs in May and June. About the latter part of June, the dry season commences, and lasts till the middle, and sometimes the end, of September. The yearly rainfall at Bismarckburg is over 59 inches; at Accra, 29; at Christiansborg, 22.6. Half the storms come from directions lying between north-east and south-east, most of them from the north-east. Tornadoes are most frequent before the commencement of the rainy season. The most singular phenomenon on this coast is the *Harmattan*, a dry wind, laden with dust, and often bringing with it hazy and cloudy weather. On the Senegal it follows an east to east-south-easterly direction; on the Gold Coast and near the mouth of the Niger, a more northerly course; and it blows most frequently in December and February."

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

THE SITE OF KARAKORUM.

At the meeting of the Geographical Society of Paris held on the 23d of May last, M. N. Yadrintzef, the well-known Siberian traveller, read a paper upon the archæological mission in North Mongolia, with which he was intrusted by the Irkutsk section of the Imperial Geographical Society of Russia. The special object of the expedition, as we learn from the "Proceedings of the Royal Geographical Society," was to determine the exact site of the city of Karakorum, the ancient capital of the Khans of Mongolia,—a question which has long been in dispute ever since the visit of Marco Polo. M. Yadrintzef started from Kiakhta on the 10th of June, 1889, and followed the course of the Selenga to the point where it debouches into the Orkhon. The first ruins were met with on the river Tula; viz., those of the ancient abode of Irkhe-Merghan, son of Altai Khan, which dates back from the thirteenth century. Several parts of the ruins were in a very fair state of preservation. On June 23 the expedition visited the remains of an ancient Buddhist temple on the river Kharukha, the walls of which are still from twenty to forty feet high, and nine days later arrived at the celebrated ruins of Kara-Balgassun, situated on the left bank of the Orkhon, about thirty miles south of its confluence with the Urtu-Tamir. A close examination of these ruins convinced the traveller that they formed the remains of an ancient city, which must have covered an area six miles in circumference, and the centre of which, the Kara-Balgassun of to-day, was occupied by the principal palace of the Khan. Canals connected this city with the river Djirmanta. In the vicinity of the hot springs, near the latter river, the remains of baths were found. The position of the ancient capital of the Mongolian Empire can thus be accurately fixed, thanks to the recent astronomical determination of the situation of Lake Ughei-Nor, made by Col. Pievtzof. The lake lies in latitude 47° 47′ 23″ north, and longitude 102° 45′ 25″ east of Greenwich; and the position of Karakorum is, according to M. Yadrintzef, thirty miles to the south-east, or in latitude 47° 15′ north, and longitude 102° 20′ 15″ east of Greenwich. Another result of this expedition is the discovery of remains of the ancient habitations of the Mongols along the whole valley of the Orkhon. Several burial-grounds visited by the expedition were full of stones covered with inscriptions, bas reliefs, and obelisks. Most of the latter have Runic inscriptions and Chinese hieroglyphics. The tombs bear evidence of great antiquity, and apparently belonged to the ancient nobles of the country. A visit was also paid to the Buddhist convent of Erdenitzan, where an important religious festival was witnessed, in which more than two thousand lamas took part.

A DRILL TO CUT SQUARE HOLES.

There have been attempts at various times to devise a drill which would produce square holes as economically as round holes are drilled. The idea has been a favorite one with inventors, but hitherto no great amount of success has attended their efforts. Recently, however, machines for the purpose have been devised that work with some degree of success. Two of them are now on exhibition in London. As described in *Engineering*, they bear a general resemblance to drilling-machines; but the spindle, instead of revolving in close-fitting bearings, has a peculiar motion which causes it to cut out a square hole. In the earlier type of machine the spindle is fed down through a long rotating sleeve. This sleeve is made to follow a path of peculiar form by means of a cam at each end running in a square hole. The method of setting out the cams is thus explained: "A square hole is described equal to the hole to be drilled. From any point in one side of the square an arc of a circle is described with a radius equal to the side of the square. From the points where this arc intersects the sides of the square, other equal arcs are described, completing the curve triangle. The square in which the cam is to revolve is now drawn, and from each of the vertices of the curve triangle two arcs are described, which complete the figure shown. The point of the tool, which cuts with one edge only, must be situated beneath one of the angles of the triangle." There are a separate pair of cams and a separate tool for each size of hole to be drilled. Five sets of cams are fixed on the spindle, and any set of them can be placed opposite the bearing-plates. The later form of machine is simpler in its construction, and will drill any sized hole within the range which it covers. In the upper bearing there is a short hollow spindle which is driven by gearing. Through this spindle there passes a long hollow spindle, carried near its lower end in a ball-bearing which allows considerable freedom. At the upper end of the spindle there is a roller which runs in a fixed cam path, and is held up to it by springs, which connect the spindle with the hollow driving-spindle. The effect of this arrangement is, that while the spindle rotates, it also rolls round in the ball-bearing, and its lower end describes a geometrical figure. The drill-spindle proper is within the second spindle, and carries a cutter, the cutting edge of which terminates on the centre line of the spindle. As the central spindle is raised or lowered, it decreases or enlarges the size of the hole drilled, while the whole drill-head is lowered to give the feed.

HEALTH MATTERS.

Microbes in Hail-Stones.

Bacteria of various kinds have been found in ice and snow; and Dr. Fontin, a Russian observer, has now proved that hail-stones are not free from them. He has found, says the *British Medical Journal*, that the water produced by the melting of hail-stones contains, on an average, 729 bacteria per cubic centimetre. Neither yeast fungus nor mould was present, but nine different kinds of

bacteria were found, five of which (*B. mycoides, liquefaciens, luteus, sarcina lutea*, and *aurantiaca*) are already known. As the ordinary dwelling-place of the *Bacillus mycoides* is the earth, we are confronted with the fact that microbes of terrestrial origin may be carried up into the air, and thus rain, snow, and hail may be the direct means of conveying infection.

Mechanism of Respiration in the New-Born.

Dohen, from a study of this subject at the clinic of Königsberg, reaches the following conclusions, as we learn from *The Brooklyn Medical Journal:* 1. The respiration of the new-born is thoracic. 2. The elevation of the thorax begins at the summit, and descends progressively. 3. The tidal air averages 35 cubic centimetres, and reaches a maximum of 120. 4. The exchange of air is feeble in the first days after birth; at the end of the first week is a third larger than the first day. 5. Generally at the first inspiration the lungs are not filled with air, the alveoli unfolding only on the second day (a fact of medico-legal importance). 6. The respiratory curves of the new-born present no stationary points.

The Art of Medicine *vs.* the Science.

What Emerson said of the poet is applicable in its degree to the true physician: "As the eyes of Lynceus were said to see through the earth, so the poet turns the world to glass, and shows us all things in their right series and procession: for through that better perception he stands one step nearer to things, and sees the flowing or metamorphosis. . . . The poet alone knows astronomy, chemistry, vegetation, and animation; for he does not stop at these facts, but employs them as signs." It is not enough for the physician to know anatomy, physiology, chemistry, and pharmacology: he must not stop at knowing these, but must put them into the alembic of his brain, and transmute them into medical science. It is stated in the *British Medical Journal* that Professor Huxley said that it would be simply manslaughter for a doctor to treat his patients on the raw and undigested principles of physiology. Medicine must therefore never be looked upon as a mere science, because it is much more than that, it is wisdom sublimated from many sciences; and this is why the Gulls, the Jenners, and the Clarks can never be as common as the mere scientists who work by rule and scale. When Coleridge was accused of plagiarizing, in his "Hymn to Chamouni," from the poem of Frederica Brun on the same subject, it was easily explained, that, though he had taken her framework and used certain of her ideas, he had done so simply to glorify and endow them with life. With her they were dead phrases: Coleridge created the "Hymn to Chamouni" out of them. Just in proportion as the physician can create diagnosis and treatment for the cases which come before him as living and as various as the patients which are the subjects of the different diseases, just by so much is he a true physician. The inferior mind may see the same things as the superior, but the latter alone "sees their flowing and metamorphosis." This is why patients would go and talk to Sir William Gull, and derive benefit from the conversation, though they came away with no prescription, and took no drugs from his hands. The vulgar mind cannot understand the reason of this, and the hard scientist smiles a little superiorly at the idea.

Heredity of Tuberculosis in Comparison with its Propagation.

Attention is called, in the *Lancet* of June 14, to a pamphlet on the above subject by Dr. A. Haupt, in which it is stated that among the 1,500 inhabitants of Soden there are 101 who let lodgings. In most of the houses the wives, with sisters or daughters, serve and tend the tuberculous patients who come for treatment. In many houses servant-girls from the neighboring villages, hired for the summer, help, making the patients' beds, cleaning their rooms, beating the carpets, removing the sputum. These occupations, so closely connected with the danger of infection, are, among others, the tasks of these persons; and it must be added that they prefer the severest cases, because, as more help is required, the remuneration is higher. In winter the members of the landlords' families occupy the rooms in which generally the most severely affected patients have lain, — the rooms on the ground floor. Between 1855 and 1888, 48 of the 233 members of such families died, 10 of them of tuberculosis. In 6 of these 10 cases, heredity was demonstrable, and the remaining 4 were due to colds and external causes. Of the 415 servant-girls, 17 died, 5 of them of tuberculosis, also demonstrably due to other causes than infection. Within 30 years, then, among 653 persons, most of whom were for several summers with and in attendance on the patients, there were 15 deaths from tuberculosis, none caused by infection. The same proportion prevails among other persons in close contact with consumptive patients, attendants, washerwomen, etc. As to the general mortality of Soden, the following data are interesting: 76 persons died during the last three years, 10 aged from 80 to 85, 11 from 70 to 80, 9 from 60 to 70. Of these 76 deaths, 7 were due to tuberculosis, including 2 cases of tuberculosis meningitis in children, and 1 of tuberculosis of the bones, also in a child. Of the 4 other cases, only 1 was that of a person who came in contact with patients, and this was a case of alcoholism, ending in phthisis.

The Transmission of Typhoid-Fever by the Air.

Dr. Bordas, as we learn from a contemporary medical journal, has instituted experiments to determine the relation between the humidity of the atmosphere and the transmission of the typhoid bacillus. A current of dry air completely devoid of germs was conducted through a vessel containing a beef-broth culture of the bacillus, and into a second vessel containing sterilized beef-broth. The second vessel remained sterile. The result was the same when a dry atmospheric current was passed over pumice-stone saturated with a culture of the typhoid bacillus. When moist air was passed through the same vessels, a very different result was obtained. The sterile beef-broth culture was found, after the lapse of a quarter of an hour, to be thickly planted with the bacilli.

In nature this state of humidity is supplied by mist or fog, and statistics show an increase of typhoid-fever in Paris during the months of October, November, December, and January. The most general mode of propagation of typhoid-fever is by the contamination of the soil or water, but there are cases in which it is manifested by pulmonary localization. The germ may penetrate into the bronchial system, in spite of every means of defence possessed by the organism. Metchnikoff's studies prove that the lungs are a phagocyte battle-ground. In typhoid infection, due primarily to pulmonary lesion, it would seem that the phagocytes of the lungs are ordinarily sufficient to prevent the development of the infectious germ, and that contagion by means of the air can take place only when the macrophagic cells cease to offer an obstacle to the invasion of the microbe.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Temperature in Storms, and High Areas.

IT is an axiom, that, in making any special investigation as to the relation of cause and effect, we must separate out all influences tending to confuse and mask the special cause or force which we are studying. We may form an abstract conception beforehand of what effect we may expect to follow a certain cause, but we shall be seriously misled if we allow this hypothesis to take the place of a careful analysis step by step in our investigation. For example: suppose we reason, regarding the deposition of dew, that a fleece of wool suspended horizontally six feet above grass ground will collect more dew than one on the ground, because the warm ground will give up its heat rapidly, and prevent the lower fleece from cooling as much as the other. If we try the experiment, we shall find our reasoning entirely disproved by the facts. We have ignored the fact that the air near the upper fleece is in constant motion, and also that the heat of the earth cannot communicate itself to the tips of the wool fibres. Again: if we wish to find the pressure of the air at Mount Washington, for example, we may reason that since the pressure at

Portland, Me., which indicates the total pressure to the top of the atmosphere, is 29.93 inches in January, and 29.81 inches in July, therefore the pressure at Mount Washington must be .12 of an inch lower in July than in January. This would be vicious reasoning, however, because we have ignored the fact that it is warmer in July than in January, and consequently there is more air above the mountain in the former month. If we put the question to nature, we shall find that the pressure, instead of being less in July, is actually half an inch more on the mountain.

We might at once conclude that there is a reversal of the usual conditions, and that instead of having high pressure with low temperature, and *vice versa*, as we are accustomed to note at the earth's surface, we have on the mountain high pressure with high temperature, and *vice versa*, and extend our theory to storms and high areas. It seems to me this would again be very vicious reasoning: in fact, since there is a reversal of the law of pressures between sea-level and at some height, it would be impossible to connect directly the fluctuations of temperature and pressure at the two situations. May we not consider that when a storm approaches a station at sea-level it brings with it a high temperature, owing to the south winds that blow toward it, and that this high temperature must extend to a great elevation in the atmosphere? In other words, why may we not study temperature conditions without considering the pressure at all? We find that in a storm the temperature may rise twenty to thirty degrees at the earth. Let us take out all the cases in which there is a marked rise and fall in temperature at sea-level, say ten degrees in two days, and determine the conditions at the height of Mount Washington for the same days. In the following table I have taken out the temperature at the maximum and minimum points at Burlington, Vt., during the months October, November, and December, 1873, and January, February, and March, 1874, and also the temperature for the three days before and after these points. The corresponding temperature for exactly the same dates at Mount Washington (6,279 feet) were taken out. There were found twenty cases at the maximum point, and the same number at the minimum. The mean of each ten of these cases is given in the table.

	Maximum Point.				Minimum Point.			
	1st 10 cases.		2d 10 cases.		1st 10 cases.		2d 10 cases.	
	B.	W.	B.	W.	B.	W.	B.	W.
3 days before	32	20	29	18	48	34	41	24
2 " "	32	21	32	19	50	32	40	23
1 day "	44	34	42	25	42	26	35	18
At the........	51	37	48	29	28	17	22	10
1 day after...	42	26	42	24	43	29	33	18
2 days after..	31	18	29	20	44	33	40	22
3 " "	35	20	36	22	49	32	39	24

These results agree for each ten days, and show, that, when there is a rise of about nineteen degrees before a storm at sea-level, there is a corresponding rise of about fourteen degrees at Mount Washington; and a fall after the storm at the earth of about fourteen degrees corresponds to a fall of about twelve degrees on the mountain. The same results in an opposite direction are still more prominent on the approach and advance of a high area. These results are strictly in accord with the teachings of the most prominent meteorologists, and it seems probable that these teachings must stand against all adverse criticisms. It is very remarkable that so self-evident a truth as that a storm brings with it an increased temperature to a very great height has been sharply assailed in certain quarters. The facts are certainly strongly against these new views, and we must conclude that they could not be sustained for a moment except by ignoring the axiom laid down at the beginning of this discussion. H. A. HAZEN.

Washington, D.C., July 28.

A Scintillating Meteor.

ON Saturday, July 19, at 8.52 P.M., I saw a meteor in the eastern sky, passing through an arc of about thirty degrees in a nearly horizontal direction, at a height of twenty-one degrees above the horizon. Its course was from the south to the north; and I estimate the time during which it was visible as three seconds, rather less than more. The point where its path ended was almost due east. The light it produced was as bright as that of a common arc-lamp at a distance of some two hundred or three hundred feet. There was no sound or other marked indication of a final explosion, but there was a succession of sparks or scintillations during the latter half of its path. A luminous streak, as usual, marked the path for some little time after. J. A. UDDEN.

Augustana College, Rock Island, Ill., July 21.

BOOK-REVIEWS.

Elementary Physics. By MARK R. WRIGHT. London and New York, Longmans, Green, & Co. 12°. 80 cents.

THE author of this text-book is head master of the Higher Grade School, Gateshead, England. The book is suited for use in our high schools and academies, and should be examined by those looking for such a work. The plan is, by experiments which can be performed with apparatus readily constructed, to make the student familiar with the facts of physical science, little attention being given to the theories. This plan will doubtless lead to good results; but it is singular to note how much the theoretical considerations assist in co-ordinating the facts in physical science. It even appears that in the past, on account of defects in theory, most careful and acute observers have sometimes been obtuse in recognizing what the facts really were. The book covers heat, sound, light, magnetism, and electricity, and is to be commended to American teachers.

Heat as a Form of Energy. By ROBERT H. THURSTON, Boston and New York, Houghton, Mifflin, & Co. 12°. $1.25.

ONE of the influences which for the past hundred years has been helping along civilization has been that exerted by the employment of heat to do some of the world's rough work. As long as man used only wind-power or water-power to do his sawing or grinding for him, the question of energy—of capacity for doing work—could hardly be a very complicated one. That the motion of the wind-mill must be taken from the motion of the wind might be suspected, and so with the motion of the water-wheel; but when Watt and others had hitched a fire so as to turn a wheel, it began to dawn on philosophers that there was something in this phenomenon that called for explanation. It was soon found by Rumford and his followers that the capacity of heat for doing work was limited; i.e., that there is a mechanical equivalent of heat. But it was reserved for the students of the latter half of this century to show what are the essentials for the conversion of heat into work, and wherein it was possible to improve the steam-engine so as to prevent, as far as may be, the losses which have taken place in the past.

All this history of the development of the theory of the conversion of heat into work is traced in Thurston's book now before us.

Our author goes further, and tells us in plain language the nature of that newer form of heat engine, the gas-engine, which is now attracting so much attention, and shows us what the advantages and disadvantages of this machine are.

What the future may have in store our author does not venture to predict, but he draws attention to the evidence we have of the direct conversion in nature of oxidation processes into electricity, which processes may be imitated by man in due time, with the result of a more economic production of electricity than is now possible. When this shall be, it can readily be understood that electric prime-motors would be a possibility.

Our readers will know that Professor Thurston is the distinguished head of Sibley College of Cornell University, — a college which is in the very front rank of the schools of mechanical engineering, and will deem his clear exposition of the important subject of "Heat as a Form of Energy" as of especial interest in these days when the engines of the ocean greyhounds are so frequently astounding the world with their performances.

AMONG THE PUBLISHERS.

IN the August number of the *Jenness-Miller Magazine*, the physical culture article leads, as usual, in interest.

— John Wiley & Sons announce as in active preparation for immediate publication, "Practical Seamanship," by John Todd and W. B. Whall; "Wrinkles in Practical Navigation," revised and enlarged edition, by Capt. Lecky; and in the Ruskin Library "Seven Lamps of Architecture" (1 volume) and "Praeterita" (3 volumes).

— Mrs. Lyman Abbott, wife of the successor to Henry Ward Beecher as pastor of Plymouth Church, is to become one of the editors of *The Ladies' Home Journal* on Sept. 1 next. An English edition of this journal is to be brought out in London on a scale never before attempted by an American magazine; and Mr. Cyrus H. K. Curtis, the proprietor, and Mr. Edward W. Bok, the editor, sailed for Europe week before last to perfect arrangements.

— On Nassau Street in this city is an establishment devoted exclusively to the publication and sale of maps, charts, atlases, guide-books, globes, etc. The business was begun in a small way a few years ago, and the large dimensions it has assumed speaks well for the rapid and steady increase of public interest in geographical matters, as well as for the energy and enterprise of the proprietor. Maps and atlases have long filled an important place in the trade of many of our publishers and booksellers, but an extensive business based exclusively on cartography is a novelty on this side of the Atlantic.

— The Baker & Taylor Company have just issued "Talks with Ralph Waldo Emerson," by Charles J. Woodbury, who had exceptional opportunities for access to and intercourse with Mr. Emerson. The book is at once an epitome of his philosophy and a commentary upon the time and society in which he lived. It is largely addressed to the youth of our country who aspire to that true cultivation which was never better exemplified than in Emerson's thought, work, and life. A hitherto unpublished portrait of the Concord philosopher is printed with the volume.

— D. C. Heath & Co. (Boston) will issue shortly Anatole France's "Abeille," edited by Charles P. Lebon of the English High School, Boston; De Vigny's "Laurette, ou Le Cachet Rouge," edited by Professor Alcée Fortier of Tulane University, New Orleans; and "Selections for German Composition," with notes and vocabulary, by Professor Charles Harris of Oberlin. These selections are progressive, and each complete in itself. The book is compiled with the belief that much practice in translating easy English is better than slow and laborious work on difficult English.

— Robert Clarke & Co., Cincinnati, have in preparation an important contribution to American archæology, entitled "The Antiquities of Tennessee," by Gates P. Thruston. The author describes the recent excavations among the mounds and stone grave cemeteries of Tennessee, which have brought to light a large number of new objects, illustrating the arts and industries of the mound-builders of the Mississippi valley. Many of them have been discovered by the author, or under his supervision. More than five hundred of these objects will be illustrated in the engravings in this work, a number of them unique and of great interest.

— The July number of the *Quarterly Review*, issued in this country in the original English form, under authority of the English publishers, by the Leonard Scott Publication Company, New York, contains its usual quota of articles. The most important one, so far as Americans are concerned, is unquestionably that which closes the number, dealing with the government of New York City. This paper, entitled "Twenty Years of Home Rule in New York," treats of the ascendency of the Irish in the local government of the greatest city of America, and will undoubtedly attract wide attention. The opening paper of the quarterly, on Eton College, tells the history of one of the most ancient educational institutions in the world, and considers more especially its place in English educational history. An article on the Emperor Frederick, based on Gustav Freytag's "Reminiscences," reviews the more important events in the personal history of the ill-fated prince. The study of the modern French novel, begun in the April number, is concluded in a paper on "Realism and Decadence in French Fiction," dealing with the works of Balzac, de Stendhāl, Flaubert, Zola, Daudet, Bourgot, and some of the more recent French literary critics. An important paper on "Shakspeare's Ghosts, Witches, and Fairies" discusses the belief of the poet in the realities of these beings. An article on "The Acropolis of Athens," accompanied with a map, reviews the more important of recent archæological discoveries at this famous place and the light they throw upon the ancient Athenian civilization. An article on "Penny Fiction," which will attract great attention, considers the present state of the "penny-dreadful," and presents a characteristic picture of English literary life below stairs. Most of the publications noticed in this essay are almost unknown in America, but they possess a decided importance of their own from their wide circulation and almost total want of literary merit. The personal and political history of Sir Robert Walpole is discussed in an important study of the great statesman and his times. An article on "Western China: its Products and Trade," opens up the question of intercourse with the interior of China; and a paper on "Mesmerism and Hypnotism" brings the number to a conclusion.

— The *Edinburgh Review* for July, issued in this country in the original English form, under authority of the English publishers, by the Leonard Scott Publication Company, New York, opens with a paper on "The Earls of Haddington." The founder of this family was the most influential man in Scotland in his day; and the story of his life, and the progress of his family, are concerned with many important events in Scottish history. The recent promulgation, by the Mikado of Japan, of a monarchical constitution, serves as a text for a highly picturesque account of progress in Japan, wherein the remarkable and rapid civilization of this Oriental power is concisely depicted. The comparisons between old and new Japan in this paper will be found particularly interesting. An article on "The Life and Works of Lavoisier" gathers together many scattered fragments concerning the personal history of the celebrated French scientist, whose murder in the Revolution was one of the darkest plots upon that dark time. An essay on "The Origin of Alphabets" traces the beginnings and early progress of the most useful invention of mankind. It briefly considers the various theories that have been put forth to explain its origin, and traces the linguistic, political, geographical, commercial, and religious causes that have produced it. An article on "Montchrestien, the First French Economist," tells the story of the life and works of a man who preceded Adam Smith in the study of social science. The history of this scholar has been almost lost in obscurity, and the present is the most available account in English of the nature of his studies. Another article in social science deals with religious persecution in Russia, treating the subject historically from the earliest times to the present. It throws much light on the present status of Protestants and Catholics in the Russian Empire. A study of birds in great Britain reviews the natural history of birds native to the British Isles. Their relations to man, and general place in the economy of nature, are carefully considered. The biographical papers in the number are increased by articles on Marie Bashkirtseff, and Charles, Prince de Ligne, the latter one of the most picturesque figures in the social life of Europe in the eighteenth century. A paper on "The Campaign in the Sudan" deals with the late war in that region, and devotes considerable space to Gen. Gordon's part in it. The number concludes with the usual political article entitled "The House of Commons Foiled," dealing with the paucity of results accomplished by the present session of Parliament.

— "For the sake of the American author who is now robbed, for the sake of the foreign author who is now plundered, for the sake of that vast body of people who read books in the United States, and upon whom we now force all the worst and cheapest stuff that the presses of the world pour forth, a bill for international copyright ought to be passed. Most of all, it ought to be passed for the sake of the country's honor and good name." So writes Henry Cabot Lodge on "International Copyright" in the

August *Atlantic.* "The Use and Limits of Academic Culture," a paper by Professor N. S. Shaler, which shows the manner in which Professor Shaler believes the college could be brought into closer touch with the aims of the ordinary student, namely, the gaining of a living, is a noticeable paper of the number. Dr. Holmes ends his instalment of "Over the Teacups" with some verses which will have great vogue, entitled "The Broomstick Train, or the Return of the Witches." The Salem witches, he tells us, impatient at their long imprisonment, petitioned to be released; but, when the Evil One allowed them their liberty, they played such mad pranks, that he called them together, and, for punishment, made them pull the electric cars.

"Since then on many a car you'll see
A broomstick plain as plain can be;
. . . .
As for the hag, you can't see her;
But, hark! you can hear her black cat's purr,
And now and then, as a train goes by,
You may catch a gleam from her wicked eye."

—A portrait of the African explorer Capt. Gaetano Casati forms the frontispiece of the May number of the *Bulletin of the Italian Geographical Society.* Casati reached Cairo early in May, and letters in the *Bulletin* deal with his journey to the coast with Emin and Stanley. An itinerary of his nine years of travel, says *Nature,* shows that he left Suakin for Berber and Khartoum in January, 1880. In July of the same year he started in a sailing-boat down the White Nile to Mishra-el-Rek, and thence on foot to Wau, where he met with Gessi at the end of September. He then threaded his way southwards among the feeders of the Bar-el-Gazal to the Kongo basin, and for some time made Tangasi, on the Welle or Makua branch, a centre for exploration. Close by, at Mboro, in June, 1881, he met with Dr. Junker. Finally he made his way to Ladò, on the main stream of the White Nile; and there, at the end of March, 1883, he met Emin Pacha for the first time. Thence he walked up the left bank to Wadelai, and continued the voyage up the Albert Nyanza by steamboat. It was not until April 28, 1888, that the meeting between Emin Bey, Casati, and Stanley took place on the plateau above Kavalli to the south-west of the lake. The journey down the Semliki valley, the exploration of Lake Albert Edward, and the return to Zanzibar, are recent history. The remaining papers of the number deal mainly with South America. The most interesting of these is that of Count Orsi di Broglia di Mombello on the sculpture of the primitive inabitants of the Upper Orinoco. Many carvings on the stones of tombs have been discovered among the villages of this district: the sculpture is rough and fantastic, but evidently aims at reproducing certain natural objects. Thus, at the Grotto of Caicara, near the right bank of the Orinoco, many rocks carved in the primitive manner of the slate sketches of school-days, evidently exhibit an attempt to figure a tiger that is very common in this district. In neighboring caves were found mummies closely resembling Egyptian ones: this the author regards as further evidence of the common origin of the two races, previously suggested by the striking similarity in shape of the skulls of the South American Indians and those found in the tombs of Egypt.

—The August *Magazine of American History* is filled with a pleasing variety of papers. The opening illustrated paper, "Historic Houses and Revolutionary Letters," by Mr. Robert Ludlow Fowler, contains extracts from hitherto unpublished letters and documents relating to stormy scenes in the most exciting period of our country's annals, with a bright thread of family history—of the ancient Ellisons of colonial New York—running through the animated sketch. The second article, "Glimpses of Log-Cabin Life in Early Ohio," from the pen of Emanuel Spencer, is realistic and picturesque, bringing the log-cabin home to us in earnest, with all its limitations and ambitions. Following this, Clement Ferguson writes of the historic associations of "The Blue and Beautiful Narragansett;" Richard Selden Harvey recites "The True Story of an Appointment;" the editor contributes an epitome of the career of Major-Gen. Ebenezer Stevens, the subject of the

frontispiece; and Dr. Prosper Bender discusses "The French Canadian Peasantry." The "Prospectus of the First American Edition of Shakespeare," a curious antique treasure, appears in minor topics, and "Sixty Waymarks in the World's Progress" furnishes a list worthy of careful preservation.

— Messrs. Ginn & Co. announce to be published in August or September Shelley's "Defense of Poetry," edited by Albert S. Cook, professor in Yale University. Shelley's "Defense" may be regarded as a companion-piece to that of Sidney. Both are the productions of poets who are also distinguished for their prose; of poets essentially lyrical, whose highest praise is given to the epic and the drama; and in both a substantially identical philosophy is set forth with fervid eloquence. In their diction, however, the one is of the sixteenth century, and the other of the nineteenth. For this reason a comparison of the two is of interest to a student of historical English style. But, apart from this, the intrinsic merits of Shelley's essay must ever recommend it to the lover of poetry and of beautiful English. The truth which he perceives and expounds is one which peculiarly needs enforcement at the present day, and it is nowhere presented in a more concise or attractive form. This edition is provided with all needful helps, and is the only one now current of the "Defense" printed by itself, apart from other prose works of Shelley.

— Messrs. Macmillan will issue early next month a reprint from the collected works of Edward Fitzgerald (1889) of his famous version of the Rubaiyat of Omar Khayyam, which is practically unobtainable, except in those three volumes. The author, as is well known, never put his own name on the titlepage of any of the four editions which appeared during his lifetime, and the show of anonymity is still preserved. In accordance with their admirable custom, which other publishers would do well to follow, Messrs. Macmillan have given on the verso of the titlepage a brief bibliography. The same firm will also publish immediately the first volume of Professor Alfred Marshall's long-expected treatise entitled "Principles of Economics." It is an attempt to present a modern version of old doctrines with the aid of the new work, and with reference to the new problems of the age.

— *Babyhood* for August cautions parents against allowing children to hear too much about "mad" dogs, since hydrophobia is so rare a disease that most physicians never, in fact, see a case of it; while lyssophobia (i.e., dread of hydrophobia), a purely nervous affection, may and sometimes does prove fatal. This number of the magazine contains also a few hints as to water sports for children, and an illustrated description of the most approved methods of resuscitation from drowning. There is an article upon "Hives," and one upon "Signs of Disease in Early Life," each by an eminent physician. Various questions of diet and clothing, pertinent to the season, are discussed, and the interesting series "Kindergarten on the Farm" is continued.

— The August number of *The Forum* will contain a remarkable essay, by Prince P. Krapotkin, on "The Possibilities of Agriculture." He has made a thorough investigation of the fabulous results of the scientific cultivation of land in the most densely populated portions of Europe, and he shows the ease with which the number of acres now cultivated in the civilized parts of the world can be made to yield sustenance for many times the number of people now alive. Scientific and intensive agriculture in the United States, for instance, can be made to sustain in plenty, and with much greater cheapness than now, a population at least ten times as dense. The writer shows conclusively why it is that such slow progress is made in these revolutionary improvements in agriculture, but he predicts with confidence that we are on the eve of the reign of plenty. He proposes that a hundred acres be cultivated in this way as a part of the exposition at Chicago, in order to demonstrate the possibilities of multiplying many times the products of the American farmer.

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Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head free of cost, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

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SCIENCE

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BUTTER AND OLEOMARGARINE.

THE form and character of the fats employed as articles of food vary from the raw and solid fats of the whale and seal, eaten by the inhabitants of exceedingly cold climates, to the raw and liquid fats, mostly of vegetable origin, consumed in tropical climates. In temperate climates the form, whether solid or liquid, of animal or vegetable origin, is a matter of education.

The fats present to the animal economy one of the most important functions of food, that of supplying heat and energy. "Ten grains of butter, when burnt in the body, produce heat sufficient to raise 18.68 pounds of water 1° F., which is equal to raising 14,421 pounds 1 foot high."[1]

The potential energy of fats is greater than that of nearly all other articles of food. According to Dr. Rubner, as quoted by Professor Atwater,[2] one gram of fat yields 9.3 calories, or 14.2 foot-tons; that is to say, "when a gram (one twenty-eighth of an ounce) of fat, be it the fat of the food or body-fat, is consumed in the body, it will, if its potential energy be all transformed into heat, yield enough to warm a kilogram of water 9.3° of the Centigrade thermometer, or, if it be transformed into mechanical energy such as the steam-engine or the muscles use to do their work, it will furnish as much as would raise 1 ton 14.2 feet, or 14.2 tons 1 foot."

A gram of proteine, myosin (lean) of meat, white of egg, caseine (curd) of milk, gluten of wheat, etc., or of carbohydrates, starch and sugar, yields 4.1 calories, or 6.3 foot-tons,—less than half as much energy as an equal quantity of fat. Of course, only a small portion of the whole energy is made available for external muscular work: the rest is transformed into heat. Professor von Gohren,[3] as the result of elaborate computation, reckons that a horse may transform 32 per cent, an ox may transform 43 per cent, a man may transform 53 per cent, of the whole potential energy of his food into energy for mechanical work.

In regard to the relative digestibility of butter and oleomargarine, see the article on "Foods and Food Adulterants," in *Science* of April 11, 1890, p. 229.

Butter was unknown to the ancient Greeks,—at least, no reference is made to it by Homer or Aristotle,—and even to this day is a great rarity in Mexico and South America and in certain portions of China. Herodotus and Hippocrates described, in the fifth century B. C., the butter which the Scythians obtained from mare's milk by violent agitation, and Dioscorides states that the best butter is made from sheep's and goat's milk. It was not in common use in England until after the fourteenth century. It is less frequently eaten by barbarous than by civilized nations. It is made from milk, chiefly from that of the cow. That from the bison is employed in Egypt and India, and that from the goat in other countries.

Milk is a natural emulsion, in which the globules of fat exist in a very minute state of division. Their usual size is $\frac{1}{5000}$ of an inch, but varies with the nature of the food used; and they are scattered through the whole substance as long as the fluid is in motion, but, when it is allowed to rest, these globules coalesce, and form cream.

The flavor of the butter differs according to the animal from which the milk is derived, and varies with the nature of the food, turnips and leeks imparting a peculiar strong taste. The color varies likewise with the animal and its food, from nearly white to very yellow. To give butter a uniform tint, the addition of annotto or other coloring-matter is very often resorted to.

The adulteration of butter with "additional coloring-matter" is legalized by the Oleomargarine Law,—although such addition be "intended fraudulently to conceal its inferior quality," to use the language of the British Sale of Food and Drugs Act, 1875,—and is a practice which should be more honored in the breach than in the observance than it usually is. While the coloring-matters used are harmless for the most part, their use tends to deceive the purchaser into supposing that a white, winter, is a yellow, spring, or Jersey butter.

The manufacture of butter has for its object the further coalescing of the fat-globules contained in the milk, and depends on mechanical means for its accomplishment. Butter made from whole milk, or scalded cream, contains more caseine (curd) than if made from cream in the ordinary way. This is important as not only affecting its taste, but also its keeping properties; for caseine, being a nitrogenous body, is liable to undergo fermentation, in which case the butter becomes decayed or rancid. When special pains are taken to "work the butter" thoroughly, thus more effectually getting rid of the water and buttermilk, it keeps for a much longer period in a "sweet" condition. The use of from 1 to 10 per cent of salt, and also saltpetre, as a preservative is quite common.

Ghee, which is so extensively used by the natives of India, is prepared from bison's milk. The milk is boiled, cooled, a little sour milk added, churned, hot water added, and in about an hour butter is produced. The butter is allowed to

[1] Foods, E. Smith (New York, 1874), p. 136.
[2] Century, vol. xxxiv., p. 401.
[3] Naturgesetze der Fütterung, 1872, pp. 372–378.

become rancid, when it is clarified by being boiled with dhye, or sour milk, and salt or betel-leaf, and is then kept in closed pots for use. It has a peculiar flavor, which is distasteful to Europeans.

In some parts of Europe the butter is boiled at a gentle heat for a couple of hours, with constant stirring, allowed to cool and settle, and the melted mass is decanted while still liquid into crocks, care being taken not to allow the caseine, or cheesy mass, to intermix. The butter so prepared will keep for a long time without becoming rancid.

Butter is the best-known of all non-nitrogenous animal foods (fats), but is consumed in very different quantities, varying from the large cupful, as drank before breakfast by the Bedouins near the Red Sea and Persian Gulf, to the thin layer, as eaten at most meals on the slice of bread by the inhabitants of this country.

Butter is defined by the Oleomargarine Law as the food-product "which is made exclusively from milk or cream, or both, with or without common salt, and with or without additional coloring-matter."

Butter is composed principally of butter-fat, with a small and variable quantity of water, caseine or curd, and some salt, which has been added to preserve it and bring out its flavor.

The following table shows the extremes in composition of numerous samples of butter, as found by various analysts, in regard to their proximate analyses :—

Tri-stearine, $C_3H_5\ (C_{18}H_{35}O_2)_3$, which occurs in almost every animal and vegetable fat. It may be obtained in a considerable degree of purity in plates of a pearly lustre by repeated crystallizations from ether. It is inodorous, tasteless, neutral, and volatilizing without decomposition under reduced pressure. It is solid at all ordinary temperatures. Its melting-point is from 52° to 69.7° C. (125.6° to 157.4° F.).

Tri-palmitine, $C_3H_5\ (C_{16}H_{31}O_2)_3$, which occurs in animal and vegetable fats, and especially in palm-oil, whence its name, and may be obtained by repeated crystallizations from hot ether, in white pearly laminæ. The crystals melt at from 46° to 62° C. (114.8° to 143.6° F.).

Tri-butyrine, $C_3H_5\ (C_4H_7O_2)_3$, which is found chiefly in butter. At ordinary temperature it is liquid, and has a distinct and peculiar taste and smell.

Tri-oleine, $C_3H_5\ (C_{18}H_{33}O_2)_3$, which occurs in almost every animal and vegetable fat. It is liquid at all ordinary temperatures, neutral, odorless, and tasteless.

Wein[1] found in butter-fat more or less of the glycerides of palmitic, oleic, stearic, myristic, arachidic, normal caprylic, capric, normal caproic, and butyric acids. Glycerides of acetic and formic acids were also found, but not those of propionic, valeric, oenanthylic, or pelargonic acids. The greater part consists of the glycerides of oleic and palmitic acids, that of stearic acid being usually present in smaller quantity. The characteristic constituent of butter-fat is butyrine, which ranges from 5 to 8 per cent.

Table I. — Extremes in Composition of Numerous Samples of Butters.

Analysts.	Number of analyses.	Water.			Fat.			Curd.			Salts.		
		Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
König[1]	123	35.12	5.50	14.49	85.25	76.37	83.27	4.77	0.25	1.29	5.65	0.08	0.95
Bell[2]	117	20.75	4.15	14.20	93.12	72.93		5.32	0.11	1.20	15.08	0.50	
U. S. Department Agriculture[3]	52	17.44	4.44	10.49				1.23	0.26	0.60	7.10	1.08	3.27
Hassal[2]	48	28.60	4.18		96.93	67.72					8.24	0.30	
Hehner and Angell[2]	30	16.00	6.40	10.57	90.20	76.40	85.15	5.10	1.10	2.18	8.50	0.40	2.09
Ellis[4]	12	10.50	4.90		89.70	80.80		4.90	1.10		6.20	0.10	
Larue[4]	12	16.50	8.00		86.90	79.14		5.50	1.50		3.60	0.40	
Schacht	8	9.00	1.25		98.00	87.00		0.50			6.00	0.57	

[1] European markets. [2] Great Britain. [3] American. [4] Toronto.

What is commonly or commercially known as a simple fat is chemically almost invariably a mixture of several different fats, called glycerides; and the name by which they are designated terminates in "ine," e.g., butyrine, stearine, etc. These glycerides are the normal propenyl ethers of the fatty acids, or, in other words, compounds of the triad alcohol, glycerine, with the fatty acids.

Glycerine has the property of uniting with one, two, or three molecules of fatty acid, affording mono-, di-, or triglycerides, designated according to the acid. In almost all the natural fats these glycerides occur as trivalent; and in speaking of them the prefix "tri" is generally omitted, being understood. The most commonly occurring glycerides are,—

Olive and cottonseed oils are composed chiefly of tri-oleine and tri-palmitine.

Mutton suet consists chiefly of tri-stearine, with small quantities of tri-oleine and tri-palmitine.

Human fat contains tri-palmitine with some tri-oleine and tri-stearine.

Beef suet contains the same glycerides and the same quantity of tri-oleine as mutton suet, but the percentage of tri-palmitine and tri-stearine is about a mean between the latter fat and human fat (Heintz).

Lard has more tri-oleine than either beef or mutton suet, and less of the other two glycerides, tri-palmitine and tri-stearine.

[1] Sitzungsber. d. Phys. Med. Soc. Erlangen xi., p. 1664.

The differences in these natural fats are due to the different proportion in which these glycerides are mixed, and to such other physical differences as the various sources of the substance under examination would produce. When subjected to chemical and physical examination, a discrimination can be made between fats and oils of different origins.

According to Blyth,[1] the general composition of butter fat and butterine (oleomargarine) fat appears to be as follows:—

	Butter-Fat.	Butterine-Fat.
Palmitine	50.00	22.3
Stearine		46.9
Oleine	42.21	30.4
Butyrine	7.69	.4
Caproine and capryline	.10	
	100.00	100.0

The following analyses, made by Drs. Brown and Mott, show the characteristic difference in the composition of genuine butter and oleomargarine to consist in the greater proportion of soluble fats contained in the former:—

	Genuine Butter.	Oleomargarine.
Water	11.968	11.203
Butter solids	88.032	88.797
	100.000	100.000
Insoluble fats:		
Oleine, palmitine	23.824	24.893
Stearine, arachine, myristine	51.422	56.298
Soluble fats:		
Butyrine, caprine, caproine, capryline	7.432	1.823
Caseine	.192	.621
Salt	5.162	5.162
	88.032	88.797

The discovery of Mége Mouries, in 1867, of a process for the manufacture on a large and cheap scale, from hitherto waste products of the large slaughter-houses, of an artificial butter, is one of the most important advances in industrial chemistry of this century. His object was to obtain a fat "which melted at almost the exact temperature of butter, possessed a sweet and agreeable taste, and which, for most purposes, could replace ordinary butter; not, of course, the finest kind, but which was superior to it in possessing the advantageous peculiarity of keeping for a long time without becoming rancid." He was employed on the Imperial Farm at Vincennes, and his experiments were undertaken at the instance of the French Government.

In 1870 a factory for the manufacture of this new butter substitute was in operation near Paris, at Poissy, and the product was called "margarine." The war then intervened, and suspended the operations of this factory; but at the cessation of hostilities they were resumed. In April, 1872, the Council of Health of the Department of the Seine, on the favorable report of M. Felix Boudet, admitted the new product to the trade under the proviso that it was not to be sold as butter. The process was patented in England in 1869, and in this country in 1873, and was described in many of the trade and scientific journals of that time.

[1] Foods, pp. 285, 287.

The process of Mége may be briefly described as follows: The fat from the loins and kidneys of freshly slaughtered beeves is thoroughly washed in cold water, 16° to 18° C. (61° to 65° F.), for two or three hours, then hashed fine and melted in steam-jacketed vats, in which the temperature is carefully regulated, with the addition of a little pepsin or a portion of the finely divided stomachs of calves or pigs, together with a little caustic alkali or alkaline carbonate, at a temperature of about 45° C. (113° F.). The charge usually is, hashed raw fat, 1,000 parts; water, 300 parts; sodium, or potassium carbonate, 1 part; and stomachs, 2 parts. The mass is stirred and kept at a temperature of 45° C. for two to three hours, and allowed to settle. The melted fat is drawn off through hair sieves from the top, and run into the settling-tanks. In these tanks the fat is kept melted at 45° C. until it becomes clear; the addition of salt, about 2 per cent, hastening the operation. The mass is then cooled at a temperature of 23° to 25° C. (73° to 77° F.), whereby a large proportion of the stearine and palmitine separates in the solid state, leaving the oleine, much of the palmitine, and some stearine in a pasty state. The mass is placed in bags and subjected to hydraulic pressure. The temperature of the pressing-room is maintained at 25° C. The oily product expressed constitutes the "oleo oil," or "oleo," which is the principal ingredient of oleomargarine. The hard fat remaining in the press is turned over to the candle and soap makers. The average yield is stated to be, hard fat, stearine, palmitine, 40 to 50 per cent; oleo oil, 50 to 60 per cent. This oleo oil is nearly colorless, tasteless, and at ordinary temperature is a soft, granular fat, rather than an oil.

To make it into the artificial butter, it is necessary to impart to it the color and aroma it still lacks. For the former, annotto or turmeric is used; and for the latter, fresh milk, cream, or genuine butter. To effect an intimate mixture of the flavoring and coloring matter with the oleo, it is necessary to emulsify the fat. Mége discovered that the udder of a cow contains a substance, extractable by water, which will emulsify the fat. The operation is carried on in churns. The usual charge is, liquid oleo, 200 pounds; fresh milk, 40 to 50 pounds; aqueous extract of the udder, 40 to 50 pounds; and coloring-matter in suitable quantity. The churning is kept up for two hours at as nearly 17° C. (63° F.) as possible. The product is treated essentially in the same way as ordinary butter,— washed, drained, salted, and packed.

The yield is stated to be as follows: one ox affords 166 pounds of crude fat; 56 pounds caul fat, giving 36 pounds of artificial butter, besides 6 pounds of scrap.

Mége's original process has been modified from time to time. The use of pepsin or of calves' or pigs' stomachs has gradually been abandoned.

Though numerous patents have been taken out in this country for the manufacture of artificial butter, and materials unknown to science specified as ingredients to be used, the process employed is comparatively simple, and not patented.

The process used in this country consists in preparing from

the suet and other fats of the beef and hog a fat deprived of the larger part of its more solid constituents, viz., stearine and palmitine, whereby a product is obtained that resembles butter-fat in certain properties.

The aim of the manufacturer is to so combine the oleo oil, neutral lard, and cottonseed oil with a certain small portion of creamery butter or cream as to produce an artificial butter having the appearance and taste of the natural product as closely as possible. There are several grades manufactured, containing a greater or lesser amount of genuine butter, which determines the price.

Sir F. A. Abel, C.B., F.R.S., in his testimony before the English Committee, stated that the process employed in one of the most extensive works in Holland was briefly as follows:—

"A quantity of milk is churned for a short time, together with a sweet oil, such as that known as ground-nut oil or sesame oil; a quantity of oleomargarine equal to about half the weight of the other ingredients is then added to this churned mixture; and the churning is then continued, at about 80° or 90° F., for about a quarter of an hour. In most cases, in order to give the true butter flavor to the butterine to a greater extent than can be obtained by the use of the milk alone, a proportion of a very strong-flavored butter, either Danish or Dutch, is added toward the close of the churning. When the mixture has been sufficiently churned, it is allowed to flow out of the churn in a stream, which meets a stream of ice-cold water. The sudden refrigeration of the mixture which I have described has the effect of preventing any crystalline formation, or the formation of crystalline particles, and produces a granular structure quite similar to the structure of ordinary butter. I should state that a small quantity of what is known as butter-coloring matter, or annotto (which is the coloring-matter used generally in the coloring of genuine butter of different descriptions), is added before the churning is completed. The butter-like substance which is obtained by the refrigerating action to which I have alluded, is passed between rolls, with the addition of a sufficient quantity of salt to render it thoroughly palatable and to preserve it; and the butterine is submitted to the usual finishing operation for sale in the market.

"Oleomargarine is the product of a treatment of what is commonly called sweet beef fat; that is to say, the fat from beef is carefully looked over in order to see that no tainted portions remain. It is then submitted to a crushing process in order that the membrane may afterwards more readily separate from the fat. It is submitted to melting, and allowed to subside for some time, so as to separate the pure fat from the membrane. The pure fat is then drawn off, and, when perfectly clear, is allowed to cool, until the mixture is rather more than semi-solid; and in that condition it is placed between cloths in a condition somewhat similar to marrow, and submitted to very powerful pressure. The hard portion of the fat remains behind as stearine, and the portion that is liquid at that temperature passes away, together with a small proportion of the harder constituents of the fat; and that constitutes the oleomargarine. In butterine there is no fat introduced except in the form of oleomargarine."

American Methods of Manufacturing Oleomargarine.

The following ingredients enter into the manufacture of oleomargarine as pursued in this country: oleo oil, neutral lard, some liquid vegetable oil (as cottonseed, sesame, or peanut); butter in the higher grades, cream, and milk, together with salt, and annotto or other coloring-matter. A brief statement of the general system pursued in the preparation of the ingredients, and of the finished products, may not be uninteresting. Very few of the oleomargarine manufacturers make their own oleo oil or neutral lard, and none of them refine or crush the vegetable oils used in the lower grades of oleomargarine, but buy them in the open market, these materials being now well-established commercial products.

The manufacture of oleo oil is generally carried on in connection with the large slaughter and packing houses situated in or near the principal cities, where every effort is made to utilize all portions of the cattle slaughtered. The caul and suet fats are removed from the freshly slaughtered beeves, and placed in tanks filled with water at 75° to 85° F., where they remain from two to three hours before being transferred to other tanks containing ice-water. By this procedure the fats are gradually deprived of their animal heat, and the danger of their becoming sour is avoided, as would happen if the mass of fat was suddenly chilled by being placed directly in ice-water. The caul, long, or slaughter fat is kept separate from the suet fat, which yields an inferior grade of oil.

A Texan steer will yield, on an average, 65 pounds of caul and suet fats, from which are obtained 28 pounds (43 per cent) oleo oil, 21 pounds (32 per cent) oleo stearine, and 12 pounds (20 per cent) high-grade tallow. The chilled fats, having been thoroughly washed to remove any blood that may be present, are then sent to the rendering tanks. These are generally in a separate building from the slaughter-house. Fat from cattle slaughtered late in the afternoon is generally kept in the ice-water tanks over night before being rendered; thus no fat is more than twelve or fourteen hours on hand, and the great majority less than four hours, before it is rendered. The fat is fed into choppers or hashers, revolving at a high rate of speed, from which it issues through fine sieves directly into the rendering-tank. This is a large steam-jacketed upright kettle of 2,000 to 5,000 pounds capacity, provided with revolving blades driven by suitable machinery. Steam being turned on in the jacket, the hashed fat is fed continuously into the tank, and kept in motion by the stirrer. When the tank is full and the contents thoroughly melted, the temperature being 120° to 155° F., the stirrer is removed, and the water and scrap allowed to settle. The clear fat is drawn off from the top, and run into the graining or seeding cars of 400 to 600 pounds capacity, where it is allowed to chill. The temperature of the room in which these cars are stored is maintained at 85° to 95° F. The fat, in chilling, naturally solidifies gradually; the hardest variety, the stearine, being the first to form a thin crust on top and sides. In from one to three days the whole contents of the car will be in a semi-solid condition. This fat is free from all "greasy" taste. The car containing the semi-solid fat is taken to the press-room, which is maintained at a temperature somewhat below that of the seeding-room, viz., 70° to 80° F., where it is dipped out by ladle and poured on a stout linen cloth, placed in a suitable depression on a wooden revolving table, and, after the cloth is properly folded so as to make a rough bag, it is transferred to the

metal plate of a screw-press. A dozen of these cloth bags cover the surface of a plate. When one plate is covered, another one is let down and filled.

When the press is filled, pressure is gradually applied by means of an endless chain revolving a screw. The expressed oil constitutes the oleo oil. This liquid fat is conducted, still hot, from the press into barrels or cars, where it is allowed to cool. The finished product is nearly colorless, tasteless, and at ordinary temperatures is a soft, granular fat, rather than an oil. The hard fat remaining in the filter-bags is removed from the press, and forms the beef or oleo stearine, which is used either for making refined or compound lard by the addition of cottonseed oil, or sold to the soap and candle makers.

The manufacture of neutral lard is conducted by essentially the same machinery and at about the same temperature employed in the manufacture of oleo oil. Only the leaf-fat of freshly slaughtered hogs is used. A hog yields from 5 to 15 pounds of leaf-lard, averaging 9 pounds, 100 pounds of which yield 90 pounds neutral. The neutral, however, is not pressed to extract the stearine, but is run directly from the rendering-tank into a very strong iced brine, where it remains for about twenty-four hours, when it is removed, and placed on shelves to drain. The neutral is a white, slightly granular, tasteless, solid fat. The skimmings and scrap from the lard-rendering kettles are strained, and the fat (about 2 per cent of the original charge) obtained from them added to the steam-rendered product. Several factories, however, use the ordinary steam and kettle-rendered lards, and not neutral. Great cleanliness is observed throughout both processes, and there is very little manual handling; machinery being used as much as possible, and the fat carefully guarded from any source of contamination.

The by-products of oleo oil and neutral — viz., stearine, tallow, and lard — are standard merchantable articles. Only fresh and sweet fats are used; and tanks, etc., are thoroughly cleaned before use, as a small amount of fat, if allowed to adhere to the apparatus, is liable to decompose in such a way as to spoil the succeeding batch of materials worked up.

Though there may be slight differences in the details, the range of temperature, size of tanks, etc., pursued by the different manufacturers, the general procedure is as above described, the object being to obtain a neutral fat, melting at butter temperatures.

The vegetable oils are prepared by crushing the seeds, etc., and subjecting the crushed mass to hydraulic pressure, or by extracting the oil by carbon bisulphide or other solvent. The crude oil thus obtained is refined to remove the coloring-matter by treatment with mineral acids, and subsequent neutralization by alkalies, and chilling and pressing, whereby a product is obtained of a light straw-color and bland taste.

The butter used is always selected for its high flavor and taste, and is generally obtained direct from the creamery. Owing to the granular character of oleo oil it becomes necessary to add some softer and smoother fat; and neutral lard and cotton-seed, or other similar vegetable oil, are added for the purpose of making the mixture more closely approach the consistency of butter. The proportions in which these ingredients are used vary with the seasons of the year, the grade desired, and the formulas of the manufacturers. The charge of milk or cream, however, is the same for all grades manufactured by any particular factory, and varies from 10 to 20 per cent. The milk or cream is allowed to become slightly sour.

The churn used is steam-jacketed, of 1,200 to 2,500 pounds capacity; and the whole operation of churning is conducted at a temperature of 85° to 105° F., insuring the melting and thorough mixture of the solid fats used, thus differing from ordinary creamery practice. The oleo oil and neutral lard are melted in separate kettles at a temperature of about 90° F. The charge of milk or cream is first run in, and the paddles kept in motion until the butter begins to form. Then the charge of melted oleo oil is added and stirred. When this is well incorporated, the neutral lard is run in, and finally the annotto, to give the desired butter-color. The butter is added either directly into the churn, being first melted, or it is worked into the oleomargarine after it is taken from the churn. The temperature is carefully regulated, being about 85° F. at the beginning, and gradually increasing to 105° F. at the end, when the whole charge has the appearance of a yellowish, creamy fluid. From twenty to ninety minutes are occupied in the churning. The whole melted charge, after it has been sufficiently churned to thoroughly incorporate all the ingredients, is run either directly into tanks containing chopped ice and constantly stirred, or is met by a stream of ice-water as it issues from the churn. The object is to give the melted mass a fine grain by this sudden cooling. The chilled mass is removed from the tanks, and placed on wooden trays to drain. Here the salt is added and allowed to work itself in, which generally takes from twelve to twenty-four hours. The salted mass is then thoroughly worked by mechanical rollers, to remove the buttermilk and water, following the general practice of creameries in this and subsequent operations of packing, etc.

Oleomargarine is placed on the market either "solid packed" or in prints or rolls. Four grades are generally made, known as "dairy" and "extra dairy oleomargarine," creamery," and "extra creamery butterine," the last two containing from 10 to 25 per cent of the best creamery butter. In the lower grades, from 25 to 60 per cent of neutral lard, from 20 to 50 per cent of oleo oil, from 5 to 25 per cent of vegetable oils, and in some cases from 2 to 10 per cent of butter, with 10 to 20 per cent of milk or cream, are the proportions used. Some factories employ no vegetable oils in their oleomargarine, preferring to use a larger proportion of neutral lard with a small amount of butter to obtain the desired butter consistency. In the higher grades the proportions of oleo oil are reduced, the vegetable oils are discarded, and creamery butter is used to make up the charge.

[To be continued.] EDGAR RICHARDS.

NOTES AND NEWS.

IT is reported that a deposit of coal of good quality has recently been discovered in West Australia.

— The enormous increase in the frozen meat export trade from New Zealand during the past few years must be exceeding gratifying to all persons interested in the colony. The value of the exports to Great Britain in 1882 amounted to only about nine two thousand dollars, while in 1887 it had risen to upwards of two million dollars. Over a million carcases of mutton are now sent annually to England, and there seems to be every prospect that the trade will go on increasing at a similarly rapid rate.

— A very odd result of rivalry between two tiger-snakes is recorded by Mr. D. Le Souef, Assistant Director of the Melbourne Zoölogical Gardens, in a recent number of the *Victorian Naturalist*. One of the snakes was large, the other being small. Not long ago both happened to fasten on the same mouse, one at each end. Neither would give way, and the larger snake not only swallowed the mouse, but also the smaller snake. In about ten minutes nothing was seen of the smaller snake but about two inches of its tail, and that disappeared next day.

— In an experiment made by the North Carolina experiment station, a series of plots was laid out in such manner that one end of each plot should be on land on which cow peas had been previously plowed under, and the other end on land without peas. The whole was sown to wheat, and kainite, acid phosphate, and cotton seed meal were applied to the several plots, singly and in combination, two plots being left without any fertilizer. The result was that on the land which had had no cow peas the highest increase of any of the fertilized over the unfertilized plots was four bushels per acre (for 300 pounds of cotton seed meal), while on the green manured land the increase from the pea vines was from six bushels at the least to fifteen bushels per acre, averaging ten bushels.

— With all their learning and teaching power, the German universities retain some rather unlovely traditions, of which duelling is perhaps the most redolent of barbarism. True, the vast majority of "hostile meetings" between undergraduates seldom result in more than facial disfigurement; but sometimes, when firearms are the weapons chosen instead of swords, danger is inevitable, and even death may occur. A melancholy illustration of this has lately been witnessed at Wurzburg, where, as narrated by the *Lancet*, a highly promising and amiable "candidatus medicus" lost his life. Paul Fleurer, the unfortunate youth in question, seems to have played a truly chivalrous part in the encounter; for after a first, and then a second, interchange of shots, he held out his hand twice in token of reconciliation with his antagonist, but in vain. A third interchange was insisted on, and poor Fleurer fell mortally wounded, and died in a few minutes. At his funeral, which was attended by the students in large numbers, and with all the insignia of mourning, *oraisons funèbres* were delivered, the principal of which referred to the deceased as the victim of an "unfortunately still prevailing prejudice"— surely an inadequate condemnation of a practice which finds no favor in the better-mannered academic life of Great Britain and America.

— A bulletin of the Ohio Agricultural Experiment Station, now in press, gives the results of an experiment in feeding sugar beets to milch cows, made during the past winter, together with a summary of two similar experiments, one made by the station in 1889 and one by the farm department of the Ohio State University in 1879. In the last named experiment eight cows were kept under test for eleven weeks; in 1889, twelve cows for eight weeks; and in 1890, twelve cows for nine weeks, the cows in each case being weighed daily, as well as their feed and milk. In each of the three experiments the cows ate more hay and more total dry matter when feeding on beets than on other foods (hay, meal, and bran in 1879, corn silage in 1889 and 1890), and in each case more milk was given from the beets than from the other foods, but it is not yet demonstrated that the increase of milk was produced economically. For twelve years records have been kept on the farm now occupied by the station, which shows that the average yield of beets over this period has been nearly sixteen tons per acre, against an annual yield of about fifty-five bushels of shelled corn per acre. But a crop of fifty-five bushels of shelled corn, with its fodder, will contain nearly twice as much dry matter as sixteen tons of beets, and these experiments indicate that, whether fed dry, as corn meal and dry fodder, or as corn ensilage, the dry matter of the corn crop will be found about as effective, pound for pound, as the dry matter of the beet crop. It is possible to raise much more than sixteen tons of beets to the acre. One crop of two acres is reported at thirty-seven and one-half tons per acre, and smaller areas have given still larger yields, but such crops require very rich land and thorough culture. Whether it is possible to produce a pound of dry matter in beets as economically as it can be done in corn is not yet definitely settled, but the probabilities are against it.

— A Royal Commission has been appointed in England to inquire and report "what is the effect, if any, of food derived from tuberculous animals on human health, and, if prejudicial, what are the circumstances and conditions with regard to the tuberculosis in the animal which produce that effect upon man." Lord Basing is chairman. The other Commissioners are Professor G. T. Brown, Dr. George Buchanan, Mr. Frank Payne, and Professor Burdon Sanderson.

— The following method for preserving ice in a pitcher will not come amiss to those who need it for use all night or in the sick room. Fill the pitcher with ice and water, and set it on the centre of a piece of paper; then gather the paper up together at the top and bring the ends tightly together, placing a strong rubber band around them to hold it close, so as to exclude the air. *The Medical and Surgical Reporter* says that a pitcher of ice-water treated in this manner has been known to stand over night with scarcely a perceptible melting of the ice.

—The corrosion of steel by salt water is said to be much greater than that of iron. Mr. David Phillips stated in a recent address before the British Institute of Marine Engineers, says *Engineering News*, that he had experimented from 1881 to 1888 with two plates of Bessemer boiler steel, two of Yorkshire and two of B. B. Staffordshire boiler iron. The plates were, as nearly as possible, 6 by 6 by $\frac{3}{8}$ inches, and were kept immersed in salt water. The results show a great difference between the behavior of steel and iron. The steels lost 120 per cent more than the irons the first three years, when the plates were in contact; 124 per cent more the second three years, when they were insulated; and 136 per cent more for the whole period of seven years.

— The number of vessels passing through the Suez Canal at night by means of electric light is increasing with extraordinary rapidity. The regulations for the use of the electric light went into operation in March, 1887, and during the remainder of that year (according to statistics given in *Engineering*) the number using it was 394. In 1888 the number rose to 1,611, and in 1889 it reached 2,445. Prior to March, 1887, the privilege of travelling by night with electric light had been restricted to vessels carrying the mails. Since then all ships which conform to the regulations are allowed to proceed by night. The average time of transit has also been considerably shortened. In 1886 it was 36 hours; in 1887, 33 hours 58 minutes; in 1888, 31 hours 15 minutes; and in 1889 it had been reduced to 25 hours 50 minutes. The average time for vessels using the electric light in 1889 was $22\frac{1}{2}$ hours. The shortest time taken by a steamer in the transit of the canal in 1889 was $14\frac{3}{4}$ hours, which is ten minutes less than the fastest passage on record previously.

— Artificial musk is a recent chemical achievement. A process for its production has been patented in Germany, the inventor being Herr A. Bauer, of Gisparsleben, in the Erfurt district. It is a familiar experience in organic chemistry, that on introduction of nitro groups (NO_2) into organic bodies, by action of nitric acid, a smell like that of musk is often noticed. In the present process, as described by *Nature*, pure butyl-toluol is treated with a mixture of sulphuric and nitric acid, and the nitro-compound is purified by crystallization from alcohol, the yellowish white crystals smelling strongly like musk. According to Dr. Paul (*Humboldt*), the smell is not perfectly pure, and it can be distinguished from that of musk by the perfumer, but not by the general public. Curiously, a one per cent alcoholic solution has not the smell of musk. Only after dilution with water does this come out, and the dilution may be carried far before the smell is lost. With 1 in 5,000 it is still quite distinct. Certain properties of the new product seem to render it very useful in the perfuming of soap.

— In the new quarterly statement of the Palestine Exploration Fund, Mr. Flinders Petrie gives a short report of his recent excavations at Tell Hesy, in Palestine, which, *Nature* says, prove to be remarkably interesting. The remains of Tell Hesy consist of a mound which is formed of successive towns, one on the ruins of

another, and an enclosure taking in an area to the south and west of it. The lowest wall of all—28 feet 8 inches thick, and formed of clay bricks, unburnt—is believed to be that of Lachish, the ancient Amorite city, erected probably 1500 years B.C. Phœnician pottery of about 1100 B.C. is found above its level. Later constructions are the supposed wall of Rehoboam, and remains of the fortifications made in the reigns of Asa, Jehoshaphat, Uzziah, Jotham, and Manasseh. The pottery discovered on the spot is very valuable. "We now know for certain," says Mr. Petrie, "the characteristics of Amorite pottery, of earlier Jewish, and of later Jewish influenced by Greek trade, and we can trace the importation and the influence of Phœnician pottery. In future all the tells and ruins of the country will at once reveal their age by the potsherds which cover them."

— The Brooklyn *Medical Journal* quotes from a German authority the following review of the physiological effects of saccharin, the new sweetening agent. According to the investigations of Plugge, a .03 per cent solution of saccharin entirely destroys the action of ptyalin, and hinders the action of pepsine and pancreatine. On this account it is injurious to diabetics, to whom a good digestion is very important. On the other hand, E. Gans, Stevenson, and Wooldrige express the opinion, based upon their experiments, that saccharin is not injurious to the digestive processes, but it hinders the secondary decompositions of the contents of the intestinal canal. The Royal Academy of Medicine at Madrid has given the opinion that the addition of saccharin to foods and drinks should be regarded as an adulteration, and that articles of food, or drink, so treated should be refused entrance into Spain. A similar judgment has been given by the Academy of Medicine at Rio de Janeiro. France has adopted laws forbidding its use in foods.

— The British Vice-Consul at Los Angeles, California, in a late report, has some observations on the vine and orange pests in that region. As summarized in *Nature*, the report states that the vine disease now seriously menaces the existence of the viticultural industry in the vicinity of Los Angeles. At first it attacked chiefly the "mission" vines; now, other varieties of red vines are dying, and the white varieties are also suffering. The disease first appeared in its present dangerous form in the southern part of California, and destroyed many vineyards. Professor Dowlen, an expert employed by the Viticultural Commission to ascertain its cause, and, if possible, discover a remedy, inclines to the opinion that it is due to a fungus. On the other hand, Mr. Wheeler, Chief Executive officer of the Viticultural Commission, reports that he is fully convinced that the fungus found on the dead vines is not the prime cause of their decadence, and that it attacks them only when they have been weakened by other causes. As to the *Icerya*, or "white scale," which has ravaged the orange-groves, the Vice-Consul says that a year ago many of the principal orange-growers in the vicinity of Los Angeles had abandoned their efforts to exterminate this pest, concluding that their trees must die. Fortunately, it was learned that an Australian parasite, the *Vedolia cardinalis*, had exterminated the white scale in Australia. A colony of the bugs was imported, and placed on the trees in an orchard in Los Angeles. They multiplied so rapidly that in a few months the scale was entirely exterminated in the district, and many trees which a year ago were nearly dead, have revived and borne half a crop this season.

— In a recent article on slag cements, a French authority, as quoted in a recent issue of *Engineering*, states that these cements are made by finely grinding blast-furnace slag, and mixing it with a suitable proportion of fat lime. The grinding has to be very fine, because as the cement is made by a simple mixture it is necessary that the surface on which the two constituents, the lime and the slag, react on each other should be as large as possible, if proper chemical combination is to ensue. As manufactured in France, the cement leaves only 20 per cent on a sieve containing upwards of 25,000 meshes per square inch, and only 8 to 10 per cent on a sieve with 4,500 meshes per square inch. The density of slag cements is much less than that of Portland, weighing bulk for bulk, but from .8 to .88 times as much. In general, this cement also sets somewhat more slowly than Portland, but when hardened, has, in many cases, a greater strength, particularly at early dates after setting. In some experiments still unfinished, the following results were attained with a slag cement from the Department of Isère:

Age	1 week,	1 month,	3 months.
Breaking load, pounds per square inch	473.5	568.8	678.3

These figures are higher than any attained in the tests made on Portland cements for the new Croton aqueduct. Experiments were also made with slag-cement mortar mixed with and allowed to harden in sea-water, and gave the following results; the mortar consisted of six parts by weight of cement to ten of sand.

Age.	Breaking	Weight,	Pounds	per Square	Inch.
8 days	252.0	319.9	275.1	273.0	285.8
28 "	375.4	327.0	327.0	248.4	341.2

The main objection to slag cement seems to be that if it is allowed to harden in dry air its strength is very materially reduced, and it is then liable to crack. In the town of Villefranche-sur-Saone it has been largely used for paving foot-paths.

— The dangerous overcrowding of the London cemeteries has been often commented on by the medical press of that city, says the *Medical Press*, but the evil remains almost wholly unabated. The Sanitary Committee of the London County Council has reported that no time should be lost in closing burial grounds such as the Brompton, which contains 155,000 bodies, and the Tower Hamlets Cemetery, with its 247,000 bodies crowded into only seventeen acres. The average grave is seven by three feet, and contains eight adults and fourteen children, the covering of earth being about one foot. In one instance, a committee of inquiry regarding this cemetery found eighty infants in a grave or trench of less dimensions than that of the average grave. There are twenty-one burial places, with a total extent of less than three hundred acres, holding a million and a quarter of bodies. The soil in most of these places is clay, and the process of decomposition goes on so slowly that bodies buried for a dozen years remain remarkably well preserved.

— The use of preservatives for articles intended for food and drink is an important one, both for the manufacturer and consumer, says the Brooklyn *Medical Journal*. From a sanitary point of view, it is doubtful whether any of the preservatives ordinarily added to articles intended for human consumption ought to be encouraged. Laws exist in Continental European countries prohibiting the use of certain of these preservative agents. Salicylic acid is prohibited by most of them, and the manufacturers are there beginning the use of benzoic acid, which is preservative in small amount and is not easy to detect. After a discussion at a convention of chemists at Speyer, Bavaria, on the 10th of September, 1888, the conclusion was reached that boric acid, as a preservative for foods, is to be regarded with caution. Sanitary authorities have generally spoken in stronger terms of the use of boric acid, and yet it enters into the composition of a large number of the preservatives in the market. Hirschsohn gives a description of several different boro-glycerides which he recommends for preserving foods. Boro-glycerine is prepared by heating glycerine with boric acid, in the proportion of 124 of the former to 190 of the latter. He also recommends sodium, calcium, and magnesium glyceroborates. These compounds are mostly tasteless, and quite soluble in water and alcohol. Magnesium borate is recommended as a remedy in throat affections. A. R. Rosen recommends the following method for preserving meats: Boric acid or its salts are dissolved in water and the solution is then frozen. The article to be preserved is then covered with this ice, with the result that the meats are preserved after the ice melts. Dr. E. Polenske has made an examination of ten commercial preservatives intended for meats. Three of the ten contained sulphurous acid or sulphites; two contained borax, and five boric acid; one each contained alum, arsenious oxide, salycylic acid, and free phosphoric acid; two contained glycerine, and two boroglycerine; three contained nitre, and six common salt. The one containing arsenious oxide was the only one actively poisonous, but several of the others was decidedly objectionable. Indeed, we should object to the addition of anything to our meats which is not a natural ingredient of food or cannot be converted into a compound natural to the human body.

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CONTENTS:

FOREST CULTURE IN HANOVER.

IN various parts of the United States the question has been raised, by what measures the preservation of forests and the plantation and culture of trees might be most effectually promoted in parts void of timber. In connection with this it might be desirable to learn something about the state of forest management in the province of Hanover. This province, the former Kingdom of Hanover, according to a report by Consular Agent Simon to the State Department, had rich tracts of forests in former centuries, which, in consequence of civil and other wars at various times, were reduced to desolate wastes and remained so until the first decades of the present century, particularly those extents between Hamburg and Hanover, which are known by the name of Luneburger Haide (Lunenburg Heath).

Besides those wars, another reason for such devastation is to be attributed to uncongenial management, such as division of common forests, by which they were dispersed and fell into the hands of people with small means, and thus were doomed to neglect and destruction. Those singly situated wooded tracts, for want of screenings, have greatly suffered by the detrimental, inclement winds, which is easily understood, since large forests will defy the violence of storms better than small woods.

Great credit for having made up for past neglect and faults is due to the celebrated Burkhardt, who, being a great authority in this matter, was appointed Director of the forest department in 1850. Part of the Luneburger Haide, as well as other tracts growing more and more desert by the encroachments of sand, have been wooded with great pains and trouble at his instigation. To prevent the increase of sandy deserts those tracts were at first planted with fir-trees. These could, in some parts, after a number of years, be cleared and substituted by beach and other trees. How much the forests have been enlarged in this manner will appear by the following statement: The wooded surface amounted in the year 1850 to 1,217,625 acres; 1885, 1,551,900 acres. By such plantation of trees river-bank and sea-shore tracts have been solidified. In order to promote the establishment of forests in every respect, the Government has granted large sums for the purchase of landed property unfit for cultivation to be turned into forest tracts. The Government is now keenly intent to unite again those formerly scattered wooded parts into one single tract. In the same way the Provincial Government and Klosterkammer (Administration of cloister funds) proceed by purchasing extensive stretches of soil. The Klosterkammer administers the large funds of the secularized cloisters of the former Kingdom of Hanover, now used for the support of universities, schools, and churches in this province.

Municipalities, communities, and even private individuals who are inclined to establish forest grounds and manage them rationally will receive loans at 2 per cent and even cheaper from the Provincial Government, to be reimbursed yearly by small instalments. Also, single subsidies are granted for once for the turning of large wastes into forest grounds. For the latter purpose the provincial government resorted to a new and original method, by using vagabonds, tramps, and prisoners not of a dangerous character for forest culture, and, indeed, according to experience, with great advantage both with regard to the workers and forest culture. In this manner about 9,000 acres were planted with trees by those troublesome classes within the years 1876 to 1888. Moreover, communities as well as private individuals have turned about 14,000 acres into forest grounds within the same period by means of subsidies afforded by the Provincial Government. Besides, the matter of forest culture is encouraged and promoted on the part of the Government, as well as the provincial authorities, by the establishment of nurseries, where plants and young trees are to be had at very moderate prices.

By a legal preservation of forests in the vicinities of towns pleasant walks are created for the pleasure and health of the inhabitants, without regard to the material profit of those places. At a short distance from the old city of Hanover, for instance, was the so-called Eilenreide, a forest of about 1,500 acres, which the city now partly encircles. This forest has essentially contributed to the reputation of Hanover, with regard to sanitary condition, to the extent of its being now, according to statistics, one of the healthiest cities in Germany. Several smaller towns which own extensive forest grounds and manage them in a rational way, clear by the net yielding of those woods the whole of their municipal expenses; as, for instance, the town of Munder, situated at the foot of the Deister Mountains. The town of Goslar derives an income of $25,000 to $30,000 from an extent of 7,500 acres of forest grounds. Every traveller on an excursion to Goslar and other parts of the Hartz Mountains will have admired the fine, practical forest roads which facilitate the transport of wood. It has been estimated that, by the higher prices which the town receives at the sale of the wood on account of the easier transport, the capital invested in making these roads and keeping them in good condition yields 20 per cent yearly.

SUCCESSFUL BRAIN GRAFTING.

A PAPER on the above subject, by W. Gilman Thompson, M.D., appeared in the *New York Medical Journal* for June 28, 1890. Attempts have been made to graft nearly all the different tissues of the body. Skin, bone, teeth, muscle, nerves, glands, eyes, mucous membrane, etc., have all been grafted with more or less success, but successful brain grafting has not heretofore been performed. With the exception of skin grafting, and possibly mucous-membrane grafting, the results of such experiments have been of little practical value. They are, however, of great scientific interest in demonstrating the relative vitality of different tissues and the histological changes which accompany degenera-

tive processes. The laws of atrophy and final disappearance of disused organs, so ably advocated by Darwin, are equally striking with regard to individual tissues and cells, and it is a well-recognized fact that the higher the original development of a tissue or cell has been—i.e., the more it has been differentiated or specialized from the amœba type—the more profoundly is it affected by alterations in environment or nutrition, so as to degenerate completely, or be replaced by some form of tissue like the connective, which is of lower development but stronger vitality. The result of nerve grafting and of nerve suture after complete section have varied greatly in the hands of different operators, but, despite many discouraging failures, there is no doubt that in man, as well as in the lower animals, nerve fibres may reunite when sutured even after secondary degeneration has occurred, and they exhibit restoration of function. For this to occur, however, the nerves must be in communication with some trophic centre. Nerve grafting does not succeed so well as nerve sutures in favorable cases. It occurred to Dr. Thompson recently, while studying cerebral localization in the lower animals, that it would be interesting to graft a piece of brain tissue from one side of a dog's brain to the other, or from one animal's brain into another's, and study its vitality. Of course, he had no expectation of being able to restore abolished function by the operation, but the question of vitality of the brain tissue and the course of its degeneration is a subject which is of very wide interest. The first experiments were preliminary, made in order to ascertain whether the transplanted brain would be immediately absorbed or would slough away.

No microscopic examination was made in connection with these experiments, as it was intended only to determine the possibility of the transplanted tissue adhering. Being satisfied in regard to this matter, Dr. Thompson secured a large dog and performed his experiment. A half-inch trephine was used and a button of bone was cut nearly through over the left occipital region, leaving a small attached margin so that the button could be elevated and then depressed like a little trap-door. Through the opening 2 c.c. of brain tissue were removed. A cat was simultaneously trephined and 1.5 c.c. of brain from her left occipital region were transferred in eight seconds to the opening in the dog's brain.

The features of interest of this experiment are the facts that: 1. There was complete union, through organized connective tissue, of the contiguous portions of the two brains. 2. After seven weeks the cat's brain still maintained enough vitality to be distinctly recognized as brain tissue. 3. Brains of animals of two very different species were thus made to unite. 4. The cat and dog pias presented perfect union as well. 5. There was a sympathetic degeneration of the corresponding convolutions upon the opposite side of the dog's brain. For this curious fact Dr. Thompson can not account. He had never noticed it before, in as many as fifty operations upon this region of the brain of cats and dogs, although he had sometimes seen removal of a part of the occipital region result in extensive softening of the entire hemisphere of the same side. The opposite degeneration in this case may possibly be a mere coincidence; if so, it is a very unusual and remarkable one. There was no meningitis to favor it. 6. There was descending secondary degeneration of the dog's brain on the side of the graft, as is usual in cases of simple excision of brain cortex; hence the cat's cortex had not succeeded in acting as a nutrient centre for the dog's brain.

Dr. Thompson thinks the main fact of this experiment—namely, that brain tissue has sufficient vitality to survive for seven weeks the operation of transplantation without wholly losing its identity as brain substance—suggests an interesting field for further research, and he has no doubt that other experimenters will be rewarded by investigating it.

LETTERS TO THE EDITOR.

Temperature in Storms, and High Areas.

THERE are two classes of cases in which the temperature is higher on Mount Washington than at surrounding stations at a lower level. By far the most frequent of these is when the crest of an anti-cyclone has just passed that locality. For example, on May 22, 1887, at 7 A.M., the temperature on Mount Washington was 58°, with fair weather, and wind velocity 26 miles, from the north-west. At Portland the temperature was 52°, at Boston 56°, at Eastport 44°, at Montreal 44°, the winds being from the south-east and light. The isobar 30.40 was over Nova Scotia, and that of 29.90 was over Lake Superior. On Feb 26, 1887, at 7 A M., New England was enclosed by the isobar 30.40, a low centre, 29.40, being over Wisconsin. The temperature on Mount Washington was +8°, at Portland +2°, at Montreal −10°, at Albany +8°, and at Eastport +2°. On Feb. 2, 1887, the isobar 30.90 was located directly north of New England, and there was no low centre nearer than Utah and Colorado. The temperature on Mount Washington was +5°, at Portland +4°, at Eastport −3°, at Montreal −10°. On March 6, 1887, the temperature on Mount Washington was 15°, at Portland 14°, at Eastport 15°, and at Quebec 7°. The isobar 30.60 appeared in Nova Scotia. On Dec. 31, 1886, at 7 A.M., the isobar 30.60 was located in Nova Scotia, and that of 29.80 in Tennessee. The temperature on Mount Washington was +9°, at Portland +2°, at Montreal −7°, with winds generally from northerly points except on Mount Washington, where they were from the west. On Dec. 26, 1886, the isobar 30.40 was over Maine, and that of 29.80 over the upper lakes; temperature on Mount Washington +14°, at Portland +10°, at Montreal −2°, at Albany +12°, at Boston +15°. On Jan. 17, 1887, at 7 A M., the isobar 30.50 was over the maritime provinces, and 29.30 over Michigan; temperature +20° at Mount Washington, +8° at Portland, and +17° at Albany. On Jan. 4, 1887, at 7 A.M., the isobar 30.70 enclosed New Hampshire, southern Vermont, and south-eastern New York. Within these limits at the very crest of the anti-cyclone the temperature on Mount Washington was −1°, at Portland −7°, and at Albany −4°.

Numerous other instances of the kind might be cited, and the list might be greatly enlarged also by admitting cases in which an approach to inversion of temperature was apparent although not fully attained.

The other class of cases in which there has been an inversion of temperature are much more rare and difficult to define, being due apparently to temporary anomalous conditions of one sort or another. For example, on Jan. 10, 1887, at 7 A.M., the temperature on Mount Washington was +10°, at Portland +8°, at Boston +14°, and at Eastport +30°, although a low centre surrounded by the isobar 29.50 was located in Maine. The isobar 30.00 appeared over New Brunswick, as in the previous cases, however, and the isotherms were very much crowded, there being a gradient of 30 degrees between Nova Scotia and New Brunswick. In like manner on Dec. 16, 1886, there was a low centre, 29.50, off the New England coast, and an unusually confused arrangement of the isobars and isotherms toward the north-west, a low centre, 29.80, being over Lake Huron, with the isotherms +50° over Nova Scotia and −10° near Rockliffe, Canada. Coincidentally with this anomalous condition the temperature was somewhat higher on Mount Washington than at surrounding stations.

As a rule, however, increased divergence of temperature betwixt Mount Washington and surrounding stations attends and follows the passage of cyclonic centres. For example, on April 30, 1887, the isobar 29.20 covered portions of Maine and New Hampshire, this being the very centre of the low area. On Mount Washington the temperature was 26°, at Portland 46°, at Boston, 50°, at Montreal 39°, at Albany 43°, gradually decreasing westward to the lake region, where an anti-cyclone was located. On March 25, 1887, at 7 A.M., the centre of a cyclone was exactly over New Hampshire, with pressure 29.20, and temperature on Mount Washington +20°, at Portland +39°, at Montreal +25°, at Quebec +28°, at Boston +46°, at Albany +35°. On Sept. 8, 1887, at 7 A.M., a low centre, 29.40, was at Father Point, Canada, and the barometric trough extended thence south-westward into Maine. At Mount Washington the temperature was 28°, at Portland 60°, at Montreal 54°, and at Quebec 52°. With the distribution of pressure just described, wide divergence of temperature between Mount Washington and surrounding stations is extremely common, and it is not necessary to multiply illustrations. The contrast with the comparative equalization of temperature at

these stations attendant upon and immediately following the passage of the crest of anti-cyclones over New England is very striking.

The results of these observations may perhaps be summarized briefly in the statement that temperature changes indicate their approach at the summit of Mount Washington sooner than at its base. Thus, the departure of an anti-cyclone is signalized by a rise of temperature amounting, in the cases above described, to an actual inversion of temperature as compared with surrounding stations. In like manner the departure of a low centre is marked by decided decrease of temperature at the summit as compared with lower levels. In the former case there is equalization and in the latter case increased divergence of temperature at different altitudes. Hence it follows that relatively warmer air overlaps an anti cyclone at least as far east as its crest, and in like manner relatively colder air tends to overlap the warm air at cyclonic centres, but the extent to which it does so is not so clearly defined as in the case of the anti-cyclone. M. A. VEEDER.

Lyons, N.Y., Aug. 1.

Dr. Sprung: Remarks on the General Wind-Systems of the Earth.

IN the *American Journal of Science* for April I have called attention to the recent activity on the part of investigators in the field of dynamical meteorology. In that paper no attempt was made to give any opinion as to the relative merits of the different theories advanced. There could be no doubt but that a critical review of the subject was very much needed, but it must be at the hands of some one who had mastered the different theories with a thoroughness which would permit of his making a just estimate of the value of the ideas advanced by the writers. There was no doubt in my mind as to who was a (perhaps I should say the) proper person to give us this estimate. I refer to Dr. Adolph Sprung. It was with the greatest pleasure, then, that, on taking up the May number of the *Meteorologische Zeitschrift*, I found there a paper of sixteen pages by Sprung, in which he had given his views as to the correctness of the methods and some of the main results arrived at in these recent papers.

But before giving a synopsis of this *referat*, it may not be out of place to say a few words about Dr. Sprung's work, as he is probably known to but few of the present readers in any other capacity than the author of the "Lehrbuch of Meteorology," which gives us such an excellent presentation of the modern theories concerning statical and dynamical meteorology. Dr. Sprung's contributions to meteorology extend over a period of about fifteen years, and cover a wide range of topics. But there are two distinct lines in which he has made his name especially prominent as a specialist: viz., those which relate to self-registering instruments, and the mechanics of the atmosphere. He has devised a self-registering apparatus of great accuracy, which is gradually receiving a wide adoption; and the fact that its construction is in the hands of the leading German meteorological instrument-maker is itself a guaranty of its excellence. The names of "Wild" and "Sprung" will always be associated with the development of this important branch of meteorology.

It is, however, of Sprung's connection with the second topic, that of dynamical meteorology, that I wish to make special mention at the present time. From the commencement of his meteorological labors at the Deutsche Seewarte he has been a careful student of this subject; and his acquaintance with its now extensive literature is not of a cursory nature, but admits of his using the methods and results of contributors in a manner which denotes thorough comprehension. Judging from Sprung's writings, as well as by a long personal intercourse with him, I feel justified in saying that no one has a better knowledge than he, of the contents of the hundred papers which cover the field of dynamical meteorology. I do not know of a better example of the thoroughness of this study than his review of Part II. of Ferrel's "Meteorological Researches," which he published in the *Osterreiche Zeitschrift für Meteorologie* nearly ten years ago. In this same connection I may also say that no other person has done so much as Dr. Sprung towards making generally known to Europeans the great service of Professor Ferrel to meteorology.

In the comparative treatment given by Sprung in the paper now under consideration, he prefaces it by some general remarks which are of interest to us; and I will give an abstract of these, as well as of portions of the main paper.

The general circulation of the atmosphere has been lately the subject of theoretical investigation, and principally by German investigators, although earlier — through a number of years — the workers in this field had been almost exclusively Americans, and foremost of all was William Ferrel. But in 1886 Werner von Siemens published an important paper, which was the first of the series just referred to. In this investigation the results already obtained by Ferrel in his earlier works were not made use of, and the matter was treated from the first principles. But in all of the investigations an ideal and homogeneously formed earth's surface is presupposed; that is, it is assumed to consist everywhere of water or land of like qualities. On this supposition there is built up an ideal pressure distribution and system of winds. Moreover, all of the systems agree with the view so long ago advanced by Hadley, as to the initial cause of the atmospheric circulation.

The theory of Werner von Siemens is first outlined, not because it is the oldest of the modern views, but because it is the simplest. It may be briefly stated as follows: We must conceive the air to be everywhere at relative rest; the atmosphere will then possess, by means of its absolute motion of rotation, a certain amount of living force K. Now suppose the whole atmosphere to be suddenly thoroughly stirred up. Then, according to Siemens, there will be produced an everywhere uniform volocity of rotation C, and of such an amount that the total living force is just the same as before.

We will determine C. By definition

$$K = \frac{mV^2}{2}, \tag{1}$$

where m denotes the mass of a quantity of air, and V its absolute velocity of rotation (that towards east is positive); under which supposition we have

$$V = \omega\, R \cos\phi, \tag{2}$$

where R is the radius of the earth (considered as a sphere), ω is its constant angular velocity, and ϕ the geographical latitude. In order to represent the mass m, covering a small ring at the latitude $R\cdot d\,\phi$ and radius $R \cos\phi$, we will designate by μ the mass (assumed to be uniform) over the unit of surface: we have, then, (3) $m = 2\,\mu\, R^2\, \pi \cos\phi\, d\,\phi\ (= d\,M$, where M signifies the mass of the whole atmosphere): consequently

$$K = \mu\, R^4\, \omega^2\, \pi \int_{-\frac{1}{2}\pi}^{\frac{1}{2}\pi} \cos^3\phi\, d\,\phi.$$

In general,

$$\int \cos^3\phi\, d\phi = \frac{\sin\phi}{3}(2 + \cos^2\phi) \tag{4}$$

which for the limits $\frac{1}{2}\pi$ and $-\frac{1}{2}\pi$ reduces to $\frac{4}{3}$; therefore we have finally

$$K = \tfrac{4}{3}\,\mu\, R^4\, \omega^2\, \pi. \tag{5}$$

If, now, the computation of the living force for a uniformly equal velocity C furnishes the same amount, then

$$K = \Sigma \frac{m\ c^2}{2} = C^2\, \Sigma \frac{m}{2}, \text{ or}$$

$$C^2 = \frac{2\,K}{\Sigma\, m}. \tag{6}$$

From (3) we have, then,

$$M = \Sigma\, m = 2\,\mu\, R^2\, \pi \int_{\frac{1}{2}\pi}^{\frac{1}{2}\pi} \cos\phi\, d = \phi = 4\,\mu\, R^2\, \pi. \tag{7}$$

By consideration of (5) we have, then,

$$C = R\,\omega\,\sqrt{\tfrac{2}{3}}\ (= 379 \text{ metres per second}). \tag{8}$$

Subtracting from this $R\,\omega \cos\phi$, the motion of the earth at the latitude ϕ, and we get the relative easterly motion v; then from (8) and (2) we have

$$v = R\,\omega\,(\sqrt{\tfrac{2}{3}} - \cos\phi). \tag{9}$$

It is of special interest to find the latitude ϕ_0 in which $v = 0$. This gives

$$\left\{ \begin{array}{l} \cos\phi_0 = \sqrt{\tfrac{2}{3}} \\ \phi = 35^\circ\ 16'. \end{array} \right. \tag{10}$$

For the belt between the two parallels of 35°, there must be, according to (9), a westerly air-current (east wind) which is greatest

at the equator (85 metres per second); while everywhere beyond latitude 35° there is a west wind which acquires its greatest velocity (379 metres per second) at the pole. In this computation a frictionless motion is considered. The distribution of the air-pressure corresponding to this has been worked out by Liebenow, and published in the *Naturwissenschaftlichen Rundschau*, Jahrgang III. p. 237, but it has no practical significance for meteorologists.

Ferrel's reasoning gives for v, the relative linear velocity of rotation, in the latitude ϕ, the following expression: —

$$v = R\,\omega \left\{ \frac{2}{3 \cos \phi} - \cos \phi \right\};$$

that is, $v = 0$ for $\cos^2 \phi = \frac{2}{3}$ or $\phi = 35° 16'$.

For $\phi > 35° 16'$, v is positive (west wind).

For $\phi < 35° 16'$, v is negative (east wind).

Ferrel's and Siemens's researches were independent of each other, but their apparently complete agreement is in reality only a partial one. They agree as to the dividing-line between the easterly and westerly air-currents (the first three being from the east, and the last four from the west); but the following little table shows how widely their computed velocities (expressed in metres per second) differ.

	Siemens.	Ferrel.
For $\phi = 0°$	85	155
" $\phi = 20°$	57	107
" $\phi = 35° 16'$	0	0
" $\phi = 45°$	51	110
" $\phi = 54°$	106	254
" $\phi = 70°$	220	747
" $\phi = 90°$	379	∞

In both cases there are assumed three facts: (1) The friction is not considered; (2) The initial condition is relative rest; (3) Thorough mixing of the air is accomplished by meridional motions. There are certain inaccuracies of deduction existing in both theories, so that we cannot say without qualification that one is right and the other wrong. Siemens seems to have fallen into the error of the Hadley-Dove view, that masses of air passing from one parallel to another retain unchanged their absolute velocity of rotation. It is one of the main points of Ferrel's theory, that this does not remain constant, but increases with the approach towards the axis of the earth. The following quotation from Helmholtz's memoir "Ueber Atmosphärische Bewegungen" (*Meteorologische Zeitschrift*, 1888, p. 329) shows his complete agreement with Ferrel. He says, "If we consider a rotating belt of air, whose axis coincides with the axis of the earth, and which is pushed first a little to the north and then a little to the south by the pressure of the adjoining similar belt, then, if the friction is not considered, according to the well-known general mechanical principle, the moment of rotation must remain constant." This can be true only when the angular velocity of the belt changes in an inverse proportion to the square of its radius. The two velocities at the poles obtained by Ferrel and Siemens, and given in the table, are both far removed from the true value; but in either case there would be a crowding-back of the air from the axis of rotation, because such great velocities of rotation are impossible. Ferrel, however, in his further development, so limits the theoretical conditions that these impossible velocities are modified into possible conditions. It is quite amusing that some readers of Ferrel's writings have understood him to make the ridiculous statement that all of the results found by his purely theoretical deductions do actually exist in nature; and they claim that such absurdities are sufficient to cause his theory to be rejected. It merely shows that such persons have only glanced at Ferrel's writings.

(*a*) The resistances to motion, such as friction and the like, make it impossible that such a great increase as Ferrel and Siemens figure out can occur in the relative motions of the air; and Helmholtz has given his views of this action, in the paper previously mentioned.

(*b*) Again: the mixing-up of the air does not occur in the assumed uniform manner which requires that all the air, no matter what its altitude is, which proceeds from about the latitude of 35°, reaches all other latitudes. As an actual fact, we find that the motion toward the pole, towards gradually narrowing circles of latitude, takes place mostly in the higher layers of the atmosphere, and the opposite motion in the lower layers. According, then, to the law of the conservation of areas, we owe to the upper movements the west wind, and to the lower the east wind.

The modifications of this simple scheme which are necessary to account for the observed wind phenomena are next discussed by Dr. Sprung, who gives special attention to the recently expressed views of Dr. Peruter (see *Wetter*, p. 11, 1890; also given in a lecture at Vienna, Nov. 7, 1889), concerning the lack of an upper south-west trade-wind between the two parallels of 35° latitude; his view being based on the theories of Siemens and Oberbeck, and in opposition to that of Ferrel. Professor Abbe's recent studies of cloud-motions in the tropics will be very useful in this connection. The tendency towards the origination of a tropical east wind is far more marked in the theory of Ferrel than in that of Siemens. That the actual wind circulation as marked out by these two investigators are so contradictory seems to be due to the fact that Siemens simply combined with the weak meridional surface currents the results obtained in (9), without considering that this is sensibly changed by the conditions explained under (6). Ferrel, on the contrary, carefully investigated the gradients of air pressure, and found that the east wind of the tropics could be perceived to only a limited extent.

Sprung's trite references to the recent works of Oberbeck (*Sitzungsberichte Berlin Akademie*, March 5 and Nov. 8, 1888) and Möller (*Archiv der Seewarte*, vol. 10), and his own attempt to treat this question of the upper anti-trades in an empirical manner, cannot be discussed in the present short communication. The last section (five pages) of Sprung's paper is of special importance to the student of this question of general motions, for he treats analytically the reasons for the use of the principles adopted in Siemens's paper. FRANK WALDO.

Mount Lake Park, Md., July 29.

A Brilliant Meteor.

ON Sunday night, July 27, at 11.15 P.M., while sitting on the piazza looking west, I saw a remarkable meteor, which in size and slowness of movement resembled that of 1861 (which I also saw).

It appeared from beneath the edge of one of the fleecy streaks of cloud with which the sky was full, about forty degrees above the horizon. Its path was downward, very slightly southward. When it first appeared, it rapidly increased in size to a large sphere of brilliant white light, changing immediately to a pale apple-green as it descended, followed by a train of dark-red glowing particles. Its duration above the horizon was about two seconds.

The clouds were not thick enough to obscure the light of third-magnitude stars. F.

Sea Girt, N.J., July 30.

BOOK-REVIEWS.

Hypnotism. By ALBERT MOLL (of Berlin). (Contemporary Science Series.) New York, Scribner & Welford. 8°.

HAVING noticed the general plan and scope of this work upon the appearance of the original German edition (*Science*, July 19, 1889), it may suffice to express briefly our appreciation of the value of this contribution to the English literature on hypnotism. We have had a translation of Bernheim's important work, and of Krafft-Ebbing's treatise on the subject from the more strictly medical point of view, and translations of Binet and Féré, and of Björnström, giving more general expositions of hypnotic phenomena. It is with the latter class of works that Dr. Moll's invites comparison. It is much fuller and more thorough than Björn-

ström's useful sketch, and notably more cautious and judicious than Binet and Féré's somewhat one-sided exposition. The arrangement of the work is a practical one, and its utility has been increased by the changes incorporated in the second edition; the very complete index, and notice of authors, being among them.

The growth of interest in hypnotism characteristic of the last few years is certainly remarkable. A great deal of it is due to a general interest in strange mental states and appearances on the borderland of the knowable. This interest, while a natural and in some respects a useful one, is in danger of lapsing into an idle curiosity, if not an uncritical credulity. Then there is an interest in the practical side, — the hopes of aiding the arrest of disease, and the furthering of mental and physical well-being; and there is the much more limited psychological interest in the phenomena for their value in contributing to an analysis of the elements and modes of combination of mental and physiological processes. To correctly guide public interest, avoiding a semi-morbid interest in the unusual, — a link detached from the chain that connects it with the normal, — directing attention to the essential meaning of the phenomena, their relation to facts longer known and better understood, and furthering a calm attitude of judicial poise when confronted with apparent exceptions to all natural laws, — this is a task as difficult as it is important, and must be the object of every book not appealing to a professional audience. It is as contributing to such an end that the present volume is welcome. It is not a perfect volume in this respect, but it is as good as, if not better than, any we have.

AMONG THE PUBLISHERS.

THE "Catalogue of Minerals" just issued by Geo. L. English & Co. (1512 Chestnut Streets, Philadelphia, and 739 Broadway, New York,) is more than the ordinary price-list. Every one interested in the subject should write for a copy, which is, in paper covers, mailed free. The catalogue contains classified lists of all mineral species described up to June 1, with their chemical composition and crystalographic form. We do not recall having seen so attractive and valuable a catalogue issued by any other dealers. The purpose is, of course, to furnish a price list of the firm's stock, but so much more is added that the result is one for which Messrs. Geo. L. English & Co. are to be commended.

— Lord & Thomas of Chicago announce that they have in preparation, and will issue during this month, their "Complete Directory of the American Press."

Messrs. Ginn & Co. announce to be published early in the autumn "A Synopsis of English and American Literature," by G. J. Smith, of the Washington, D. C., High School. This work contains in small compass the most important facts connected with English and American writers from the days of the Celtic bards to the present time. The first part of the book is devoted to English, the last part to American literature, each carefully divided into periods, and logically outlined. Every period is briefly described, and every writer of importance is mentioned, with the titles and dates of publication of his principal writings, the characteristics of the most celebrated authors and works being set forth in apt quotations or in a few discriminating words. A separate column on every page gives the leading events and personages of contemporary history in useful association with the literature. The rank of authors, indicated throughout the work by difference in type, is definitely set forth in a summary at the end. A list of books suggested as desirable for a course of reading is an additional feature of much value.

— It is proposed to publish a memorial volume containing selections from the works of the late William Francis Allen, Professor of History in the University of Wisconsin. Besides an introductory memoir and a complete bibliography of all his writings, including review articles, it will contain papers representative of his work in English social and economic history, mediæval history, Roman history, Western history, United States history and politics, and the classics, as well as essays upon educational and

religious topics. A few of these articles will be monographs selected from the proceedings of various learned societies with which he was associated, showing his scholarly treatment of special topics; but for the most part they will consist of reprints of magazine articles and pamphlets which exhibit his skill in uniting scientific with popular treatment, and which in their present form are in danger of being lost in the mass of periodical literature. A carefully-prepared index will be added. The book will contain not less than three hundred pages,—more, if the number of subscriptions warrants the outlay. It is perhaps unnecessary to add that there is no attempt in this venture to win profit for any one, and the entire amount received from subscribers will be spent in the execution and delivery of the work. The edition will be for advance subscribers only, and will be printed from the type, each copy being numbered. Subscription price, two dollars per copy, is to be paid upon receipt of the volume. The editorial committee consists of David B. Frankenburger, Professor of Rhetoric and Oratory, University of Wisconsin; Reuben G. Thwaites, Secretary of State Historical Society of Wisconsin; Frederick J. Turner, Assistant Professor of American History, University of Wisconsin; and Joseph H. Crooker, Pastor of Unitarian Church, Madison, Wis.

Pencil for Writing on Glass. — Melt together 3 parts spermaceti, 3 parts of talc, and 2 parts of wax, and when melted stir in 6 parts of minium and 1 part of caustic potash. Continue the heat for thirty minutes, when it is ready to be cast into forms of glass tubing. After cooling the crayon can be pushed out. Preserve in wooden boxes.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—A graduate from the Advanced Course of the Framingham State Normal School desires an assistant's position in a high school. An appointment in New England preferred. Address G., Lock Box 4, Framingham, Mass.

HYBRIDS.—A. M. Suchetet, 10 Rue Alain, Rouen, France, desires to correspond with those possessing hybrids, either living specimens or stuffed, of mammals, birds or other animals.

WANTED.—A Mining Engineer of standing and experience. One having had practical experience in Coal Mining and the manufacture of Coke preferred. Address A., care "Science."

CHEMIST.—A Harvard Graduate and Specialist in Chemistry desires a position with some manufacturing industry, or with a practical chemist. He would make an engagement to take charge of a laboratory and lecture on Chemistry. He has had large experience in the laboratory and school-room, and can give the best of references. Address J., Harvard College, Cambridge, Mass.

WANTED.—A Lady Teacher, at present teaching in England, with 12 years of very successful experience in primary work, desires a similar position in America. An appointment in the State of Ohio, or the City of New York, preferred. Excellent references, etc. Address in July or August, L. DUNCAN, Poste Restante, Stainland, Halifax, England.

WANTED.—The latest and most reliable authorities on the Occurrence, Analysis, and Practical Uses of Native Hydro-Carbons, such as Bitumen, Asphaltum, Mineral Wax, etc. Address Dr. J. E. TALMAGE, Box 1,047, Salt Lake City, Utah.

WANTED.—A position as Teacher of Natural Sciences; will teach German or English branches if desired. Address Box 235, Charlestown, N. H.

A ZOOLOGIST, acquainted with the United States, graduate (Ph.D. Freiburg, B.Sc. of an English university) of many years' standing; late Fellow of an English college; late assistant to a German university, professor of Comp. Anatomy; many years a student at two German universities; pupil of Huxley, Kölliker, Semper, Wiedersheim and Weismann; author of many well-known memoirs on Comp. Anatomy and Embryology; thoroughly conversant with all branches of the subject; fond of teaching, with good testimonials, seeks a Professorship. Address "MORPHOLOGIST," Office of Science. Other information and a few testimonials can be seen at the Office of Science.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I wish to exchange Riley's Missouri Reports, either singly or full set, for Proceedings Entomological Society, Philadelphia, vols. 2 to 6 inclusive. Will also exchange Casey's Revision of the *Stenini* of N. A. and Horn's Revision of the *Tenebrionidae*. F. M. Webster, La Fayette, Ind.

I wish to exchange a fresh and complete set of Weiss and Spier's "Necropolis of Ancon" for other books, either new or second-hand, if the latter are in good condition. What have you to offer? Address Warren Watson, Kansas City, Mo.

1,000 botanical specimens representing 250 genera in exchange for those not in my collection. Send list of duplicates, and receive a similar one to choose from. Address E. E. Bogue, Orwell, Ashta Co., Ohio.

For exchange—14 volumes (1883-1889) American Journal of Science, 10 volumes (1880-1889) American Naturalist, 21 volumes (1879-1890) English Mechanic, all in good condition for binding; also, Morris Typewriter. Wants first-class microscope, camera, chemical or physical apparatus. Address, with full particulars, E. R. Chadbourn, Lewiston, Maine.

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted—To furnish roots of *Dodecatheon Meadia*, *Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
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THE SCIENTIFIC TESTIMONY OF "FACTS AND OPINIONS." [1]

NEARLY twenty years have passed away since Professor A. Graham Bell first appeared before the American public on questions pertaining to the education of the deaf, and from that time until now his interest in this class of people has been deep and unremitting. There have been occasions when his public utterances have drawn the fire of those who differ from him; but it must be admitted that the popular leaders of deaf-mute education in the United States have granted Professor Bell the fullest liberty of investigation, have responded generously to his call for information, and at conferences and conventions have cordially welcomed him to co-operation in the debates and discussions which there take place. This is the true spirit—the only spirit, indeed, which we can afford to manifest toward this popular lay critic of our American schools. The amenities of life have not been altogether on one side. The professor has shown us marks of his favor in the shape of pamphlets and essays, which have provoked discussion and made investigation necessary. It is to be hoped that this spirit of mutual courtesy will continue to subsist. We do, however, venture to enter a gentle protest against the broad charge made against us in the *British Medical Journal* of May 11, 1889, in these words: "Philanthropy in the United States is doing every thing possible to encourage marriage among deaf-mutes. We educate them together, teach them a language of their own, so that they know nothing of English." The first part of this charge is severe enough, but we believe that the author of that statement would admit a little—just a little—hyperbole in "nothing of English." Whatever may be the delinquencies of the great body of men and women now engaged in this noble work, it must be said in their defence that they are as well equipped, as efficiently active, as enlightened in methods, and as fruitful in results, as the best that can be found abroad. We are not, however, to shut our eyes to the criticisms of one honestly seeking the improvement of our methods of instruction. The vast array of facts presented to the public in "Facts and Opinions" are not to be blinked at. They are to be met, if met at all, by a critical consideration of all the facts in the case.

In coming now to a discussion of the scientific testimony of "Facts and Opinions," we ask that we may be permitted to subject the evidence there given to that sifting process which honors no name, respects no authority, which strips itself of all preconceived notions, and chronicles only what investigation proves to be the clean, filtered truth.

[1] By W. G. Jenkins, M.A., instructor in the American Asylum, Hartford, Conn. (from American Annals of the Deaf for July).

The symposium collated by the editor in favor of his theory of a deaf-mute variety is interesting mainly for the weighty names by which the theory is indorsed, rather than by any thing of value contributed to the discussion. The presentation of this question before such associations as those that met at New Haven, Washington, and Philadelphia, had this merit, that it won at once the attention of the best thought of the country. Admitting all this, it is still true that the estimable men who composed these scientific bodies knew relatively nothing of the questions at issue; for they were questions pertaining to a particular guild, the members of which were conspicuous by their absence. Nothing could be more presumptuous than for a body of men to attempt to speak *ex cathedra* on questions which are wholly outside of their experience and observation. This is the criticism to which the men who appear in "Facts and Opinions" have justly subjected themselves. Yet this must be remembered in their favor: a member of their own fraternity has asked them their opinion on a theory of his own formulating; and, in complimentary deference to a great name, they have indorsed the theory, on what ground we shall immediately see. Such is the vicarious character of a national reputation, that a man carries with him all the weight of his special equipment, even when passing beyond the limits of his particular field. So distinguished an authority as Max Müller recently gave expression to the opinion that deaf-mutes, left to themselves, would rise no higher than orang-outangs, although he immediately qualified this by declaring himself an agnostic as to the inner life of deaf-mutes. The statement is an illustration of how far a man confessedly great in one branch of study may go wrong when treating of questions outside of his specialty.

The first place in this scientific testimony is held by Professor Edward D. Cope, editor of the *American Naturalist*. We are assured by him that a deaf-mute variety is possible. In proof of this assurance, we are informed that "the evolution of a deaf-mute variety is not more improbable than that blind species of animals should arise and be perpetuated;—a circumstance which has often occurred in the evolution of animals." Then, treating of the origin of such animals, he tells us that "disuse is the cause of blind species." He gives us a list of batrachians which are deaf, and whose deafness is ascribed to what he calls "disuse." But what possible analogy is there between the blind fishes of Mammoth Cave, whose conditions of life preclude the necessity of sight; between the batrachians living in subterranean and aquatic depths, where sounds do not enter,—and those beings living in a world where light and sound are the things most palpable to the senses? Species whose development

has been in perfect harmony with their environment are here compared to a few individuals differentiated from their kind by some abnormal variation, the abnormal factor in the case rarely of a fixed character. If the editor of the *Naturalist* can find among his blind species individuals possessing sight, or, in the depths of which he speaks, batrachians with the power of hearing, he will then present us a parallel case with deaf people in a hearing world. To affirm the possibility of a deaf race in a world of sound by the existence of blind and deaf species where there is neither light nor sound, is not the sort of evidence that our men of science are wont to rest upon in the verification of their theories.

The second witness, Professor Alpheus Hyatt, in presenting his evidence, begins with a cautious "if." He readily indorses the theory, on the ground, apparently, that all characteristics tend to become inherited. He nowhere defines what he means by a characteristic, and the question naturally arises whether he regards the ante-natal lesion of the auditory nerve or the rupture of the ear-drum as peculiarities to be transmitted. One may as well talk of a one-armed man transmitting his defect as to speak of many of those who are deaf transmitting theirs. This writer evidently does not realize that we are still in the dark as to what the physical causes of deafness are. Of adventitious deafness the causes are innumerable, but the whole field of ante-natal deafness has been comparatively neglected. Whether the few cases noted of apparently hereditary deafness are due to some malformatien of the hearing-organs, or whether they are the result of a vitiated diathesis predisposing to deafness, is a question not yet decided. We have sufficient evidence, from the reports to the British House of Commons and from other sources, to prove that scrofula is directly responsible for a large proportion of the cases of deafness.

Dr. H. P. Bowditch, the third authority quoted in this scientific symposium, has very little to say, except to assure his correspondent that he is "perfectly right" in his theory, and, in closing, to compliment him on striking a note of "warning of the danger which attends the purely philanthropic method of dealing with social problems." Just what the author of this opinion means by his last remark, it would be interesting to know. But if we may be permitted to interpret this implied censure, it is that the philanthropy which has done so much for the education of the deaf; which has made it possible for them to own farms, to be editors, lawyers, and teachers, to be factory-men, shoemakers, and carpenters; which fits them, indeed, to exercise all the rights of men and of citizens,— is also in some way responsible for what these people do after leaving school. Philanthropy really finishes its work with the education of the deaf, and then leaves them where the students of other schools are left. But it so happens that these people are social beings, that they are endowed with all those instincts which lie at the basis of our common life; and they often marry among their kind, living in happiness and peace, finding in each other's society some compensation for the loneliness of their lot; and for this, too, that abstract thing philanthropy is held responsible. Those concerned in the education of the deaf are no more accountable for the matrimonial alliances of their pupils than the professors of a university are for the marriages of the students who come under their tuition. The social problems, whether among the deaf or the hearing, are often grave enough, but surely not of a character to justify the covert charge to which this writer has given expression. The deaf married before special schools were organized, and they marry under the system which has the special advocacy of the author of "Facts and Opinions." Twenty per cent of the deaf between twenty and eighty years of age in Germany are married. That misfortunes of a special kind sometimes come upon the offspring of the deaf is not to be questioned. Every step forward in civilization develops some new evil. Education produces forgers and counterfeiters. Knowledge of chemistry has put into the hands of the criminal classes terrible forces of destruction. A long indictment against the arts and improvements of modern life could easily be made. Not one of them is an unmixed good. The dependent and delinquent classes in the last census numbered 400,000 persons. If we add to this the death-rate of all under five years of age, it will be seen that if people are to be deterred from marrying by the possible ills, moral and physical, which may fall upon their offspring, the race would soon become extinct.

The fourth authority in the testimony quoted, Professor William H. Brewer, is worthy of notice as giving the number of generations necessary to fix a new variety. "Five generations of sires and four of dams is a common rule." But in "Facts and Opinions" (p. 103) we find that a deaf-mute of the fifth generation marries a deaf woman, generation unknown, and the five children of this union all hear and speak. Another interesting fact which shows the difficulty of predicating heredity is given by a former principal of the Pennsylvania Institution for Deaf-Mutes: A deaf man from a family of five deaf children married a deaf woman from a family of three deaf children, and the seven children resulting from this marriage are free from the affliction of their parents. As long as facts of this character are to be found in great number, it is not to be wondered at that those who mingle freely among the deaf refuse to assent to the extreme statement of the case as found in "Facts and Opinions" and other published addresses. While Professor Brewer tries to prove the probability of the evolution of a deaf variety, he insists upon "fixity in the distinctive character,"—an indefinite phrase, which may mean a dozen things,—and admits that if deafness is not transmitted to the offspring as a rule, then the special points are but individual peculiarities. This admission is fatal to his theory, for the probability of transmitting a like anatomical defect is so remote as to remove the question to the domain of the doctrine of chances.

It is with considerable hesitation that one ventures to say any thing of the honored name which holds the next place in this symposium. Professor Simon Newcomb is a man of most varied learning and acquirements, a distinguished astronomer, an eminent physicist, a writer on political economy, an estimable man; and it is a matter of considerable surprise, that, with the resources of the Washington College within easy access, he has permitted himself to indorse the theory upon the *ex parte* statement of the case presented to him. It is true that the writer simply presents an hypothetical case; but there are hypotheses so reasonable as to carry in their statement every presumption of truth,

and there are hypotheses so violent as to be classed at once with the improbable. He also tries to fix the number of generations that must elapse before the deaf variety would be evolved. It is necessary to the success of the plan that congenitals marry congenitals, and the process must continue from generation to generation. The hearing children are to be eliminated from the community, and the successive unions must be between those among whom heredity is already a fixed factor. This statement of the case reminds us of Plato's ideal republic. It must consist of 11,080 persons, just as many women as men, and all additions to the number are to be banished. The nature of the facts upon which the opinion we are here considering is built may be seen from the following ("Facts and Opinions," p. 98, Italics mine): "According to the law of heredity, the *probability* [of a deaf-mute race] will increase with each successive generation. In the *absence of any exact knowledge* of this law, I shall *assume* that the *probability* of deaf-mute parents having deaf-mute children increases through successive generations according to the series $\frac{1}{5}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, etc."

But suppose the variety, along the selected lines, never reaches the one-fifth stage, or, reaching that, disappears in the next generation, what becomes of the formula? There is no evidence in this testimony of any knowledge of the disparity between males and females born deaf, and the discussion proceeds on the assumption that deafness is due to some one physical fact. If the formula has any approximation to truth, then the American Asylum at Hartford, after a history of more than two generations, ought to show some signs of it; but of the first hundred pupils admitted, beginning in the year 1817, forty-five were born deaf, while of the last one hundred, ending in 1889, forty-one were born deaf; so that after seventy years of deaf-mute education, with its enormous proportion of deaf-mute marriages and the asserted increasing percentage of deaf-born children, the proportion born deaf remains practically unchanged, the slight change which has occurred being a decrease. Our quarrel with this scientific testimony is that throughout the discussion thus far assumptions and probabilities have taken the place of facts, and types of development containing nothing irregular have been compared to an artificial process of fixing and propagating a defect.

It is with great pleasure that we turn from the previous testimonies to the few pages contributed by Professor W. K. Brooks, professor of morphology in Johns Hopkins University. Here we have a clear, concise, scientific exposition of the subject. He is the first of these scientific men to begin with a careful definition of what an inherited characteristic is, and the only one to note that a congenital peculiarity is not necessarily an inherited peculiarity. He divides the deaf into four classes: viz., 1. Accidental deafness after birth; 2. Loss of hearing by accident before birth; 3. Cases where there is an inherited predisposition to deafness; 4. Cases of inherited deafness.

The conditions for the evolution of a deaf-mute race, as set forth by Professor Brooks, are that those among the deaf who marry must have the same inherited peculiarity. From this statement of the case, I doubt whether any of those most familiar with the deaf would dissent. The only comment they would be likely to make would be that marriage among the deaf of those having the same inherited peculiarity is as rare as marriage between people with red hair. Professor Brooks has also the candor to give us the opinion of Professor Galton, somewhat contradictory of the views set forth in his discussion. But there can be no question that the law of regression, as announced by Galton, will assert itself; and there will be a constant tendency, even among the children of parents having the same peculiarity, to revert to the normal type. The evolutionary process which produced hearing ought in time to repeat itself, and individuals in the variety would soon multiply, and the defect in time be eliminated. The reference of Professor Brooks and of all the writers to the experience of breeders is not quite pertinent, for in none of the cases referred to was the point to be transmitted a defect. Success in the progressive development of new species ought not to be cited to prove that the attempt would be equally successful in a process of deterioration. This much is evident, that, if a deaf-mute variety could ever be formed, it would only be after rigorous selection among those whose heredity had already become a fixed quantity, under the controlling purpose of making the experiment a success. That this will ever take place, the wildest pessimist of the future of the deaf will hardly venture to claim.

The above is part of the testimony presented by Professor Bell to the British House of Commons. It is also part of the indictment of our American system of instruction. It is well, however, to look abroad, and note a few facts in regard to those countries which are claimed to be so much in advance of ours. In Italy, the home of the pure oral method, more than 70 per cent of the deaf can neither read nor write ("Report to the British House of Commons"), while in the six New England States only 10.8 per cent are illiterate. We have, however, fuller statistics from Germany. Taking the thirteen German provinces, and comparing them with the same number of our States most populous in deaf-mutes, we have to each 100,000 inhabitants the following deaf-mute population:—

German Provinces.	Number of Deaf-Mutes in 100,000 Inhabitants.	United States.	Number of Deaf-Mutes in 100,000 Inhabitants.
East Prussia	182	Indiana	91
West Prussia	182	Utah	84
Posen	154	West Virginia	84
Pomerania	127	Wisconsin	83
Hesse Nassau	101	New England	78
Brandenburg	97	Kentucky	78
Silesia	97	New York	75
Hohenzollern	92	North Carolina	74
Hanover	78	Missouri	74
Rhine Provinces	78	Ohio	72
Saxony	76	Maryland	72
Westphalia	74	Pennsylvania	72
Berlin	65	Tennessee	72

These figures prove with irresistible force that the number of deaf-mutes in a community is not due to the use of the sign-language, nor to the congregate system of housing pupils, for neither of these prevails in Germany.

When it is further remembered that this is a new country; that malignant types of such diseases as cerebro-spinal meningitis and scarlet-fever have swept through whole communities, in some cases more than doubling the percentage of our deaf-mute population; that the incoming of a large foreign population, with all the ills attending the

opening-up of new lands, has also helped to swell the number of the deaf,—there is certainly something to glory in, that we have still a much smaller percentage of deaf-mutes than the ideal countries we are invited to take as our models.

BUTTER AND OLEOMARGARINE.

THE wholesomeness of artificial butter has been affirmed by eminent chemists and physiologists, both in Europe and in this country, who have devoted attention to this subject, when it is prepared from carefully selected and sweet fat of healthy animals, and the process conducted in a proper and cleanly manner. (See in this connection the statements of Dr. C. F. Chandler of the School of Mines, Columbia College, New York; Professor Henry Morton, Stevens Institute, Hoboken, N.J.; Professor G. F. Barker, University of Pennsylvania, Philadelphia; Professor G. C. Caldwell, Cornell University, Ithaca, N.Y.; Professor S. W. Johnson, Sheffield Scientific School, Yale College, New Haven, Conn.; Dr. J. W. S. Arnold, University Physiological Laboratory, New York, submitted to the Senate Committee on Agriculture and Forestry; and by Sir F. A. Abel, Mr. Herbert P. Thomas, Mr. A. H. Allen, president of the Society of Public Analysts; Mr. Otto Hehner, secretary of the Society of Public Analysts; Dr. James Bell, principal analyzer to the Commissioners of Inland Revenue, and others before the English Select Committee.)

Mr. Herbert P. Thomas, principal clerk of the Local Government Board in charge of the Public Health Department, stated in his testimony before the Select Committee[1] that they had no evidence that butterine was injurious to health. "It is a very curious thing that our inspectors have connected epidemics with a very large number of substances; for instance, epidemics have been supposed to be connected with milk, with cream, with hams, and with cheese, but not with butter or butterine."

The most scrupulous cleanliness should be observed in the manufacture of oleomargarine. Even a small amount of fat, if allowed to adhere to the apparatus and utensils used, is liable to decompose in such a way as to spoil the succeeding batch of materials worked up. Fats can undoubtedly be deodorized by means of chemicals, but it is very questionable whether they could be used as butter substitutes, owing to the increased expense involved to make them perfectly tasteless, as it is very hard to get rid of the tainted taste.

That there is a remote possibility, especially when the cattle and hogs are not inspected by a competent veterinarian before slaughtering, of the fats used containing parasitic organisms may be granted, but the remedy is self-evident. The chance of disease being conveyed in this way is very small, but not yet proved to be non-existent.

Against oleomargarine there has been a large amount of legislation directed, with a view of controlling its production and sale, and with the unexpected result of increasing both.

Whatever may have been the production of oleomargarine in this country before the national law went into effect, we have no reliable statistics; but since the 1st of November, 1886, we have the monthly statements of the manufacturers, duly attested under oath, of the quantity of oleomargarine made and removed from the factories, tax paid for domestic consumption, or in bond for export, each day of the month. These statements also give the quantity and kind of materials employed in the manufacture, and the name and addresses of the parties to whom the oleomargarine is sold or consigned.

Table IV shows the quantity of oleomargarine produced in this country from Nov. 1, 1886, to Nov. 1, 1889.

Table IV.—Showing the Quantity of Oleomargarine produced, withdrawn Tax paid, for Export, and Lost or Destroyed in Manufactories, from Nov. 1, 1886, to Nov. 1, 1889.

Year.	Quantity Produced. Pounds.	Withdrawn Tax paid. Pounds.	Lost or Destroyed. Pounds.	Withdrawn for Export. Pounds.
On hand Nov. 1, 1886...	181,090			
From Nov. 1, 1886, to Oct. 31, 1887.........	31,114,682	29,692,966	55,260	1,029,880
Highest, March, 1887.	3,568,254	3,512,138	12,472	96,499
Lowest, July, 1887....	1,208,638	1,170,136	1,191	33,240
From Nov. 1, 1887, to Oct. 31, 1888.........	35,530,146	33,655,423	6,442	1,937,907
Highest, March, 1888.	3,940,727	3,824,672	2,998	155,761
Lowest, July, 1888....	2,084,317	1,925,762	185	155,200
From Nov. 1, 1888, to Oct. 31, 1889.........	35,132,060	32,902,802	6,741	1,694,851
Highest, Dec., 1888...	4,181,317	4,025 336	10	109,385
Lowest, June, 1889....	1,575,362	1,514,658	—	58,579
On hand Oct. 31, 1889...	429,219			
Total for 3 years..	101,786,888	96,251,191	68,443	4,662,638

These figures are interesting because oleomargarine is the only food substitute about whose production and sale we have positive knowledge.

During this period the number of factories decreased from 37 to 21, notwithstanding which fact the production and sale increased steadily. Oleomargarine is produced by expensive machinery in the large factories in such quantities that it can be sold nearly the whole year round at a less price than butter, although the high rate of tax paid by both the manufacturers and dealers, which is, of course, ultimately paid by the consumer, necessarily increases the market price. In the spring and early summer months dairy butter is generally cheaper than oleomargarine, and consequently less of the latter is made and sold during that time. In July the production of oleomargarine reaches its lowest limits for the year, and obtains its highest in March.

The system followed by the Internal Revenue Bureau is such that each manufacturer's package can be traced from the time it leaves the factory till it reaches the hands of the retailer or consumer, or leaves the country.

The high rate of tax demanded from the manufacturers and dealers was undoubtedly intended to be nearly or quite prohibitory; when compared with those paid by other special tax-payers, rectifiers, brewers, etc., as shown in Table V, the amounts are from three to ten times as high.

[1] P. 9, Special Report from the Select Committee on the Butter Substitutes Bill, ordered by the House of Commons to be printed, July 4, 1887.

Table V.—Rate of Special Taxes per Annum.

	Oleomargarine.	Liquors.		Tobacco Manufactured.
		Distilled.	Malt.	
Manufacturer........	$600 00	$200 00[1]	$100 00[2]	$6 00
Wholesale dealer.......	480 00	100 00	50 00	30 00[3]
Retail dealer............	48 00	25 00	20 00	2 40

[1] Rectifier of 500 barrels, or more, per annum.
[2] Annual manufacture, 500 barrels or more.
[3] Pedler of tobacco, first-class.

It is undoubtedly a fact that if the retailer's tax were as low as that for tobacco, the manufacturers of oleomargarine would pay the same to have at least one dealer to handle their goods in every village and town in this country. As it is, in the Chicago district, where there are seven factories, there were 974 retail dealers doing business in April, 1889, compared with 726 the April previous; in the Boston district, with its one factory, there were 460 retailers in April, 1889, and 405 at the corresponding time in 1888; in the Connecticut district, with four factories, there were 424 in 1889, and 384 the year previous; and in Michigan, with no factory, there were 290 and 267 respectively for the same periods. These four collection districts contain over one-half of the total number of retail dealers doing business at the close of the special tax year ending April 30, 1889. This would seem to indicate that where the public has been brought in unprejudiced contact with oleomargarine, as sold on its own merits, they have found it palatable and suitable to their wants.

I have been in retail stores in the lumber and mining regions of the upper peninsula of Michigan, in Boston, Chicago, and elsewhere, where as much as one-half to one ton of oleomargarine is sold per week, in quantities of less than ten pounds to any one purchaser at one time, put up in packages duly branded with the word "Oleomargarine," as required by the law and regulations.

From a personal inspection of some of the largest factories, I am convinced that the greatest cleanliness is observed throughout all the operations; that nothing but the freshest animal fats are used; that machinery is employed as much as possible, and large quantities worked at a time, to reduce the expense. The factories are as well arranged as the best creameries; and it is to the manufacturer's interest to produce a palatable and wholesome product, which is, however, not intended to compete with "gilt-edge" butter.

In April and May, 1888, with the aid of the local Internal Revenue officers, I made an inspection of the material sold for butter in several of the large cities. Over eleven thousand samples were collected, and it must be said that about ten per cent of these were unfit for human consumption, being exceedingly rancid, and in many cases actually putrid; nevertheless they were genuine butters, and not mixtures containing foreign fats. In our large Eastern cities there are dealers in low-grade butters who put on the market what is known as "ladle-packed" or "hash" butter, a compound of the remnant stock of country dealers worked up "with additional coloring matter," to please the eye and make the mass uniform. It is about as savory a grease as "prime steam lard." One effect of the oleomargarine law has been that dealers in "hash" butter have to sell it on its own merits, and not call it oleomargarine for an excuse, when their customers complained of its rancid taste, as they did before the law was passed.

A few years ago the dairy commissioner of one of our large States considered it necessary to issue a circular to butter makers, especially to those having one or two cows, embodying certain directions in regard to handling milk and butter, which implies such want of common cleanliness in these manipulations by the ordinary butter makers, that I cannot refrain from quoting from it:—

"Third.—Be clean and decent about your milking. Never wet the teat with milk and let the drip from your dirty hands drop into the pail to spoil the flavor of the milk. Remove the milk from the stable or all impure odors as soon as possible. Use no milk pails or milk vessels of any kind made of wood, but have all made of tin, and never use them except they are scalded with very hot water and made perfectly sweet and clean.

"Fourth.— . . . Have loose covers on the cans to prevent flies, bugs, and millers getting into the cream, and put this whole business [the cans] in some room or place where all the foul odors of a kitchen or pantry can not spoil its flavor.

"Sixth.—When you strain the milk into cans, have your cloth milk-strainer folded from four to six thicknesses, so that all manner of filth that ever gets into it will be taken out. Scald the cloth then thoroughly. Never use an old sour strainer for this work. . . . Have a thermometer to test this [the temperature of the cream], and not stick your finger in to tell by."

I am afraid that the butter makers of this State are not the only ones guilty of such practices.

Where butter is made in small quantities at a time and "salted down" between churnings, and some time elapses before the tub is filled, the lower layers have probably commenced to ferment, and before long the whole lot is rancid.

When care is taken, as in large creameries, the butter maker never experiences the least trouble in selling his product the year round at a remunerative price, and it is only the careless man, who makes an inferior article, that experiences this difficulty.

The adulteration of butter with water and salt is as much a fraud on the public as the addition of foreign fats, coloring matter, or any other form of deception. Water and salt are expensive luxuries when one has to pay at the rate of twenty-five to forty cents a pound for them, yet that is what happens if a purchaser buys four pounds of a butter containing twenty per cent of water and five per cent of salt —not an uncommon case.

There is a special provision in the law in regard to the use of any unwholesome material or product in the manufacture of oleomargarine, but no sample has ever been submitted to the Commissioner of Internal Revenue under it.

Owing to the construction by the Attorney-General of Section 2 of the oleomargarine law, the internal revenue officers exercise no control over the production and sale of oleo oil, although the Commissioner has recommended that Congress amend the law in that regard. From inquiries that were made in June, 1888, by the collectors of internal revenue, there was found to have been produced during

the year ended June 30, 1888, 69,623,795 pounds of oleo oil in nine States. There were used in the manufacture of oleomargarine, as stated in the manufacturers' returns, 12,265,-800 pounds during that period, and 30,146,595 pounds were exported, leaving 27,211,400 pounds used otherwise. As oleo oil is sold at a much higher rate than tallow, it is presumable that this large quantity is used in some other food products, as emulsified cream and cheeses.

EDGAR RICHARDS.

NOTES AND NEWS.

IT is proposed to construct a railroad tunnel under the Narrows in New York harbor, to connect Long Island with Staten Island. A company has been incorporated to build the railroads connecting with the tunnel, and part of the route has been surveyed. The total length of the tunnel will be less than two miles, a great part of the way through easily worked stone.

— The first convention of the North American Association for the Propagation of Volapük will be held in Boston, Aug. 21, 22, and 23. According to Article IV. of the Constitution, "Any Volapükist may become a member by sending one dollar to the Lepenädan," Mr. C. C. Beale, No. 180 Washington Street, Boston, Mass. This entitles to the grade of membership called kopanel or associate member. "Upon proof of proficiency a kopanel becomes a kopanal or active member. Only the latter may vote or hold office."

—The thirty-ninth meeting of the American Association for the Advancement of Science will be held at Indianapolis, Ind., beginning on Aug. 19. Members desiring to attend are expected to pay full fare at the point of starting, and should have the ticket agent furnish a certificate which will entitle the holder, upon being indorsed by the secretary of the association, to a return ticket at one-third of the regular fare. The railroads of the country are divided into different passenger associations, and if the member's route covers more than the territory covered by one such association, a separate certificate must be taken covering each association's territory traversed. The railroad companies have established the following rule: "No refund of fare will be made on any account whatever because of the failure of the parties to obtain certificates." The local secretary, or assistant, will be in attendance at a temporary office in the Union Station, or immediately opposite, during the first two days of the meeting, while members are arriving, to furnish any special information which may be desired. The place of meeting is in the new Capitol Building, where rooms will be furnished for all the officers, sections, and committees under one roof. The post-office authorities have kindly arranged for a branch office at the Capitol, so that all mail matter will reach its proper destination if addressed, "Care of A. A. A. S." A room will be provided for storage of apparatus and specimens sent by express, and all packages may be addressed "in care of the local secretary." The council will meet at the Denison Hotel parlors at noon on Tuesday, Aug. 19. The opening general session will be on Wednesday morning at the Capitol Building, when President Mendenhall will resign the chair to his successor, Professor Goodale. On Wednesday evening the retiring president will give his address in Plymouth Church. This will be followed by a reception of the association by the local committee and citizens at the Institute for the Blind. With the exception of Saturday and Sunday, the sections will hold morning and afternoon sessions until Tuesday evening, when the general closing session takes place. On Monday afternoon a special train will take the botanists to South Waveland. The Science Club, of Terre Haute, has invited Sections B, C, and D to hold their session at Terre Haute on Friday, where a visit will be made to the Rose Polytechnic Institute. The citizens of Lafayette have extended an invitation to Section F to visit Lafayette. The above invitations from Terre Haute and Lafayette will be accepted if approved by the council. On Wednesday a special excursion will be run to the Mammoth Cave. On Saturday an extensive trip will visit the gas territory of Indiana, and a visit will be made to the largest plate glass factory in the United States, and other concerns where natural gas is applied to manufacturing uses. For all matters pertaining to membership, papers, and business of the association, address the permanent secretary, Professor F. W. Putnam, until Aug. 15, Salem, Mass.; after Aug. 15 at the Denison Hotel, Indianapolis, Ind.

—A steam life-boat which recently made her trial trip in England is described by the London journals as being built of steel, with fifteen water-tight compartments. The boiler and engine rooms are brought up about three feet above the main deck, and are closed by iron covers to the man-holes, air being supplied by forced draught. The passengers' space is abaft the engines, seated all round, and will hold about thirty persons. The mode of propulsion adopted is a turbine, taking in water through the bottom of the boat at its apex, and discharging the water when it has attained its maximum velocity through tubular orifices on each side. About one ton of water per second is discharged. The speed at which the vessel ran on her trial trip was over eight knots. From full speed ahead the vessel can be stopped in thirty-two seconds, and way can be got on her again in four seconds. She carries a mast with some sail power forward, the mast being lowered when needful. The new life-boat is stationed at Harwich.

—If we follow the march of the vicissitudes of temperature, evidently determined by some cosmical agency, says *Nature*, we find at the beginning of Tertiary times a moderately warm climate; then a rise during the Eocene, and then a gradual cooling, interrupted possibly by some oscillations, down to a degree nearly corresponding to that now prevailing, at the beginning of the Pleistocene epoch. Then the cooling continued below the present temperature, to a minimum at the time of the greatest glaciation of the land; then a re-warming in the inter-glacial period nearly up to the present temperature; after which cold and glaciation regained the upper hand, finally to give way to the present conditions, which are about midway between the greatest warmth of the Tertiary age and the greatest cold of the Pleistocene. One fact stands out conspicuously, viz., that these changes progressed very irregularly, and were subject to much oscillation, and the period during which we can approximately follow the course of the change is much too short to enable us to learn the law that regulated it. We can not decide whether oscillations like those of the Pleistocene will be repeated, and we are now progressing towards another temporary Glacial period, or whether we have to expect the return to a warmer temperature such as prevailed in Tertiary times, or, finally, whether the outcome of all the deviations will be a lasting refrigeration of our climate. Just as little can we determine at present by what agency all these vicissitudes are brought about; most plausible and simple would it certainly be were the sun a variable star that at different periods emits different quantities of heat; but for this or any other assumption there is no proof forthcoming. This enigma, like so many others, will some day be solved by man's searching intelligence, but, like all other acquisitions of science, this goal can be won only by assiduous and patient labor. Haply the triumph may not be for our generation; but what we may certainly accomplish is to prepare the way to it, by an accurate and critical collection of the facts.

—In no other Scandinavian country is school education a State affair to the same degree as in Sweden, says a correspondent of the London *Journal of Education*. Not only are the higher secondary schools public, as in Norway and Denmark, but all primary schools are subject to public regulations and controlled by public functionaries, and the elementary teachers are appointed by the authorities. Likewise, the intermediate schools are nearly always public institutions, whose masters are civil servants, with all the duties and privileges resulting therefrom. In Norway, intermediate school education is in most places municipal, with State subvention, although the towns which have public secondary schools also have public intermediate schools; while in Denmark the intermediate schools are always municipal or private. The result of the Swedish system is that their schools are excellent, as the public appointment and the independent position of almost all the teachers greatly contribute to attract talented young

collegemen to a scholastic career. As in Denmark and Norway, no teacher can be appointed in primary schools, or to the lower classes of intermediate schools, who has not studied at a training college. In the higher classes of intermediate schools and in the secondary schools nobody can be appointed who has not passed the so called teacher's examination at the University. To pass this examination necessitates, in all the Scandinavian countries, a course of studies of five to six years at the University. All the teachers appointed have, accordingly, all the scientific requirements for a good teacher. Another salutary result of the system is that the school education is not expensive, being almost gratuitous, which has the effect of opening a career for all in the civil and clerical service. On the other hand, this nearly free education has, as a matter of course, given rise to a large conflux of office-seekers and place-hunters, and has, on the whole, made the struggle for life not any easier among the professional classes.

—It is stated by the *Engineering and Mining Journal* that the project for making Paris into a port is now completed, and nothing remains but the sanction of the Government to put the works into the hands of the contractors. Hitherto the Government has kept aloof from the proposals until its promoters were in a position to carry out the undertaking to a successful issue, a caution engendered by the recent failures of French engineering undertakings. The promoters have now raised the necessary capital, amounting to £5,400,000, and it is probable that the sanction of the government will be given to the project, and the work of canalizing the Seine with a view to allowing the passage of sea-going vessels from Havre to Paris will be proceeded with, and extensive docks will be constructed at Pantin, on the north-east of the city. Another proposal is for the construction of a canal to connect the Mediterranean with the Bay of Biscay, with the intention of intercepting a great part of the shipping which at present passes through the Straits of Gibraltar. If these two projects be carried out, they will have an immense effect on the trade of France.

— An East India newspaper, quoted by *Nature*, reports the result of a recent expedition to investigate the upper course of the Irawadi, the source of which, as is well known, is one of the still unsolved problems of geography. It has long been known from native report that two rivers, the Mali Kha and the Meh Kha, the former from the north, the latter from the east, unite a little below 26° north latitude to form the Irawadi. The sources of the Mali Kha are known to be in the mountains to the east of the Brahmakund, which form the south-eastern water-parting of the Lohit Brahmaputra; but the Meh Kha, which is stated to be the larger stream, and which Colonel Walker supposes to be identical with the Lu River of Tibet, has never before been seen by any European. The junction of these two rivers has now for the first time been reached by an expeditionary party ascending from Bhamo. On May 27, Captain Barwick, of the Indian marine, accompanied by Mr. Shaw, the Deputy Commissioner of Bhamo, and Major Fenton, of the Intelligence Department, left Bhamo in the "Pathfinder," a paddle-steamer of about thirty-five tons, with a view to reaching the point of confluence. From Bhamo as far as Maingna the stream is well known. Above Maingna the river runs between mountains from one thousand two hundred to two thousand feet high, and a succession of rapids has to be passed through, which by dint of hard struggling and after many attempts the "Pathfinder" successfully ascended, not, however, without several hairbreadth escapes from foundering, the whirlpools simply taking charge of the vessel. After six days' steaming, the party reached the confluence of the streams, distant about one hundred and fifty miles from Bhamo. Here the river was found to be five hundred yards wide, one branch, the Mali Kha, trending to the north-eastward, the other, the Nmaika (Meh Kha of the map), to the eastward. Up the former the explorers proceeded some six miles, and then came upon a series of rapids. It was decided not to go further, as the small quantity of fuel remaining was reserved for steaming up the other branch. A halt of a day was made, and the position fixed in 25° 56′ north latitude, and 97° 38′ east longitude. Returning to the confluence, Captain Barwick proceeded three miles up the Nmaika, when a rapid prevented further progress. The Kachins are said to have been very friendly, though they had never seen or been in communication with Europeans before.

— In the second part of the first volume of the Transactions of the Royal Society of Victoria Mr. A. W. Howitt, in a well-arranged and instructive paper, deals with the organization of Australian tribes. The following are among Mr. Howitt's conclusions, as given in *Nature*:—(1) The group is the sole unit. The individual is subordinate in the more primitive form of society, but becomes more and more predominant in the advancing social stages. Thus group marriage becomes at length completely subordinate to individual marriage, or even practically extinct and forgotten where descent has been changed from the female to the male line. (2) An Australian tribe is not a number of individuals associated together by reason of relationship and propinquity merely. It is an organized society governed by strict customary laws, which are administered by the elder men, who in very many, if not in all, tribes exercise their inherited authority after secret consultation. (3) There are probably in all tribes men who are recognized as the headmen of class divisions, totems, or of local divisions, and to whom more or less of obedience is freely given. There are more than traces of the inheritance by sons (own or tribal) of the authority of these headmen, and there is thus more than a mere foreshadowing of a chieftainship of the tribe in a hereditary form. (4) Relationship is of group to group, and the individual takes the relationship of his group, and shares with it the collective and individual rights and liabilities. The general result arrived at is that the Australian savages have a social organization which has been developed from a state when two groups of people were living together with almost all things in common, and when within the group there was a regulated sexual promiscuity. The existence of two exogamous intermarrying groups seems to Mr. Howitt to almost require the previous existence of an undivided commune from the segmentation of which they arose.

— In his monthly report for July, Arthur Winslow, State Geologist of Missouri, states that the work of detailed mapping in the coal fields has progressed without interruption, one hundred and ten square miles being covered in the field during the month. A portion of the results of this work has been reduced and transferred to the final sheets, two of which will soon be in a condition for engraving. Detailed work has been started in Randolph County, and Professor C. H. Gordon, of Keokuk, Iowa, a volunteer assistant for the summer, has been assigned to this work. On July 7 detailed work was started in Greene County under Professor E. M. Shepard of Springfield, local assistant on the Survey; with him is Maj. E. W. Newton of Bolivar, also a local assistant. Over fifty square miles have been covered in that county. The detailed mapping of the crystalline rocks in south-east Missouri has also progressed uninterruptedly, and about seventy square miles have been covered. Field-work on the clays and building stones of St. Louis has been completed, and the report on the results is in course of preparation. In the Laboratory the report on the mineral waters of Henry, St. Clair, Benton, and Johnson Counties has been written and is ready for publication. It will be issued in the next Bulletin. Further analyses of thirty limestones have been made, some nine miscellaneous specimens have been determined or analyzed for the Survey, and sixteen lots of specimens from outside parties have been examined and reported upon. Preliminary inspections have been made in Clarke, Scotland, Randolph, Monroe, Marion, and Franklin Counties, with the object of determining the character and amount of work which will be necessary in the future in the sections which they represent. In the office, a large amount of time has been spent in labelling and filing away for future reference and study the already bulky collection of the Survey, which now includes over one thousand three hundred specimens. A large number of valuable illustrative specimens have been collected during the past month, in addition to these, and will soon be shipped to the office. Some progress has been made in the arrangement of specimens in the cabinet, for exhibition, a few of which are now classified and labelled. Paleontologic work has been in progress in Henry and St. Clair Counties.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

SLATE PRODUCTS.

RECOGNIZING the value of prompt publication of statistics, a report from the Division of Mines and Mining, under the charge of Dr. David T. Day, of the United States Geological Survey, is issued as a bulletin by the Census Office. It shows the product of slate during the calendar year 1889, as prepared by Dr. William C. Day, special agent in charge of stone. The bulletin shows also the value of slate, the number of men employed, the wages, and other expenses, and the capital involved in this industry. This statement is exact for the entire country, but is only a brief summary of the more important facts, which will be published in detail in the complete report. The investigation was principally pioneer work. When it was begun, eight months ago, there was not even a good list of the producers of slate, and no investigation so complete as even the brief results here presented had ever been successfully prosecuted. The total value of all slate produced in the United States in 1889 is $3,444,863. Of this amount, $2,775,271 is the value of 828,990 squares of roofing slate, and $669,592 is the value of slate for all other purposes besides roofing. As compared with the statement of the Tenth Census report of 1880 on stone, the roofing-slate product of 1889 is nearly twice as great in number of squares and in value. A consideration of the slate used for purposes other than roofing appears to have been omitted from the Tenth Census report. The total value of all slate produced in 1889 is more than twice as great as that considered in the Tenth Census. According to "Mineral Resources of the United States, 1888," the total number of squares of roofing slate produced in that year is 662,400, valued at $2,053,440. Twelve states at present produce slate. A line drawn on the map from Piscataquis County, Me., to Polk County, Ga., and approximately following the coast outline, passes through all the important slate-producing localities. According to amount and value of product, the most important States are, in the order named, Pennsylvania, Vermont, Maine, New York, Maryland, and Virginia. In Georgia, Michigan, New Jersey, Arkansas, California, and Utah productive operations are of limited extent, and in the case of the latter three States, of very recent date. Inasmuch as in slate quarrying the initial operations are those of stripping and excavating, preliminary to actual output, some time must necessarily elapse before any returns for labor can be realized. For this reason the expenses incurred in Arkansas, California, and Utah exceed markedly the value of the output in those States. The twelve States referred to do not include all those in which merchantable slate is known to exist, since discoveries promising good results for the future have been made in a number of other States, among which may be especially mentioned Tennessee, where operations of production are beginning. The slate quarrymen of the country, and to a considerable extent the firms operating the quarries, are either Welsh or of Welsh descent, many of them having learned the methods of quarrying slate in the celebrated quarries of Wales. The quarries are operated on an average of about 220 days in the year. The idle days are the result of rainy weather and holidays. The first day of every month is regarded as a holiday by the Welsh quarrymen, and no work is ever done by them on Saturday afternoons.

HEALTH MATTERS.

The Wearing away of Teeth.

MR. MACLEOD, at a meeting of the Odonto-Chirurgical Society, said, according to the *Lancet*, that, having his attention drawn by a single case, he had been led to examine the teeth of various bag-pipers, and all of them represented wearing away of the cutting edges of the six front teeth, in a greater or lesser degree, varying with the density of the tooth structure and the time engaged in pipe playing. He found on inquiry that, on the average, it took about four years to make a well-marked impression, but that once the enamel edge was worn through the wearing away was more rapid. Every one was aware of the way in which the tobacco-pipe wore the teeth of the smoker, but this was not to be wondered at, the baked pipe-clay being a hard and gritty substance, but that a horn mouth-piece should have such appreciable effect was, he thought, a matter of curious interest. He mentioned, however, that the mouth-pieces suffered more than the teeth, the average life of a horn mouth-piece being twelve to eighteen months, that of a bone or ivory one being about two years. The peculiarity noticed was a crescent shaped aperture on the cutting edge of the front teeth in three localities, namely, between the central incisors and between the lateral and canine on both sides.

The Deficient Water-Supply of Paris.

It is a matter of surprise, says *The Lancet*, to all visitors of this gay city that the French, who assume to be in most things in the van of all other nations, should be so very backward in their water and sanitary arrangements in general. Each year as the summer returns a notice is published by the Municipal Council of Paris to the effect that owing to a scarcity of drinking water this latter will have to be temporarily replaced by water from the Seine. Although only temporarily, the Municipal Council seem to forget that one single draught of this water may be sufficient to cause death, as it is now generally admitted that river water is the vehicle of the germs of typhoid-fever, cholera, and of many other epidemic maladies. This arrangement does not extend to all Paris at the same time, but three are four arrondissements in succession are submitted to it for a term of twenty days. The excuse for this lamentable state of things is that the public coffers will not admit of the outlay necessitated by the arrangements for bringing spring water into the city, and yet millions are spent on less necessary purposes. It is all very well to open boulevards and squares, and to plant trees in all directions, but water is as indis-

pensable as air. M. Ferdinand Duval, late Prefect of the Seine, in writing on the subject made the remark that water should not only be in sufficient quantity but in abundance, and a city in which the inhabitants have only a very limited supply of water at their disposal he compared to a ship in distress. It appears that the senate has just voted the bill for supplying Paris with drinking-water from the Vigne Springs in the Avre Valley. It will be four years, however before Paris feels the benefit of this decision, as the works cannot be completed before that period.

International Congress on Alcohol.

The International Congress on Alcohol will hold its sittings in Christiania, Norway, on Sept. 3, 4, and 5; and the programme, as given in *The Lancet*, gives promise of highly interesting and, we trust, fruitful discussions. The report of the president of the permanent committee (Dr. Forel, of Zürich) will review the work achieved in lessening the evils of drunkenness between 1887 and 1890, after which papers will be read as follows: "The Means which have Proved most Effective in Norway for the Diminution of Alcoholism;" "The Results of the Gothenburg System;" "The Alcoholic Question in Relation to the Rearing of the Young;" "The Degeneration of Indigenous Tribes through the Spirit Trade;" and "Freely Diluted Alcoholic Beverages, or, in other words, Moderation as a Means of Combatting Intemperance." Other papers on branches of the drink question will be read by Dr. B. W. Richardson, Professor Böhmert, Dr. H. Von Hebra, Dr. H. Kurella, and other distinguished promoters of the temperance cause. Many non-medical or lay friends of the same social reform will take part in the proceedings, the attractiveness of which will be materially enhanced by an exhibition of writings, illustrations, and various other objects bearing directly or remotely on alcoholism in all its ramifications. A similar exhibition was held at the last meeting of the Congress (at Zürich), and proved an excellent adjunct to the discussions.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The Eskimo of Cape Prince of Wales, Hudson's Strait.

(THE substance of this letter was read at the last meeting of the American Association for the Advancement of Science.)

One of the chief troubles to contend with in making notes upon the customs of the Eskimo is their extreme sensitiveness to ridicule, and it is therefore most necessary that you should put on your gravest expression when questioning them. Sometimes this sensitiveness is very interesting to watch. Upon one occasion, when employing my favorite Eskimo, Ugaluk, as an assistant in my boat, and telling him to throw out the anchor, he immediately picked it up and carrying it to the bow was in the act of casting it overboard without a rope attached to it. We were just in time to stop him, and naturally laughed, rather immoderately, at which he sat down in the boat and covering his face with his hands remained in that position for a long time, and was too shy to speak to us.

If offended at any time with their own people, or either of my men, they would immediately leave, and, without saying a word, would go home, and for some time they were not to be seen. We sometimes regretted that they could not be offended oftener, for most of them required continual watching when anything movable was about.

One afternoon several men entered our house, and, standing near the fire, refused most positively to go out. Knowing that promptness of action has a good effect upon them, one of them was immediately handled rather roughly, and stumbling, fell as he was bundled out of the door, the others following suit. For a minute we thought there was going to be trouble; the next moment, however, they picked themselves up, and, all turning with smiling faces, said "*Chimo, chimo,*" which means "We are friends." I may add that orders to leave our house after this were never disobeyed.

While, as a rule, the Eskimo looks upon the white man as born to do him favors, those met with would sometimes offer payment for our services; and for the burial of an aged relative, who died when his friends were away hunting, one of my men received the valuable gift of about two gallons of blubber, which of course he accepted with many thanks. Nevertheless, if an Eskimo was given an unusually valuable present, he would immediately turn round and ask for the most impossible things, as though he thought you were now in a good humor, and now was the time to get all he could from you.

As far as could be seen, it seemed to be the general belief that all property, especially in the way of food, belonged to everybody in common, and therefore, if you held more than another, it was only because you or your family were physically strong enough to protect it Few men, of course, would steal from one another when food was plentiful, thereby making enemies for themselves, but, when food is scarce, might is right, and all make note of the position of their neighbors' caches before the winter's snow covers them.

At one time, after a raid had been made upon my storehouse by some rather desperate Eskimo, my trusted friend Ugaluk informed me that his wife had gone to get a share of the plunder. At first we were inclined to harangue him for infidelity, but soon saw he had not the slightest idea it was wrong to receive stolen property. Upon another occasion, under similar circumstances, I induced Ugaluk to help me track the robbers, and, with some trouble, we traced them to a deep gorge, where all we could see was a large hole in the snow. This was the doorway of an igloo ten feet below the surface, which had been covered by continuous drifting of the snow. Into this hole Ugaluk dived, while I remained outside. He soon returned and asked me to follow, which I did upon my knees for some distance, until I found myself in a very dirty dimly-lighted room. Sitting near the lamp was a woman, and by her were three children, these being the only occupants of the place. The woman denied most emphatically any knowledge of the theft, and was not moved in the least when informed that her husband would stand a chance of being shot if he took part in another burglary. Feeling that perhaps after all we were mistaken, we were just leaving, when the woman called us back, and, holding up a small piece of salt beef, said this was all her husband had taken, as unconcernedly as though she had never denied it, and as though he had found it outside our door instead of having done a great deal of damage in securing it.

The Eskimo, of all races, are the most free, and in no case do they consider a man their superior unless he or his family are physically stronger or are better hunters than others. These superior men are treated with little deference, though they are usually sought for in the settlement of disputes, and sometimes act as public executioners. Ugaluk, who had all these qualities, was usually obeyed when an order was given by him, and we were much interested with his story of a comparatively recent execution which he undertook for the good of the community. Walking up to the offender, he held him in conversation for a few minutes, when suddenly, drawing a knife from his sleeve, he plunged it into his breast, and then finished him upon the ground, afterwards carrying his body out upon his kyak and dropping it into the sea. As Ugaluk related his story, in a whisper, he trembled violently, and it was quite evident he was haunted with certain fears.

As in civilized communities, there were several restless individuals living among those we met, who at different times had dwelt in many parts of the coast, one of whom at least had lived far up Fox Channel. These individuals are employed as traders, and evidently are the means of keeping the language intact.

As is well known, work is pretty well divided among these people, the men doing all the hunting and making and repairing implements, while the women take part in everything else, even in the making of boats and building houses, though the more laborious part of this work is performed by the men. When moving to a distant part of the coast, a small pack is put upon each dog, and the men and women divide equally the heavy goods to

be carried. When the snow is soft, the dogs are shod with sealskin shoes.

The Eskimo's powers of endurance are wonderful. During the winter of 1885–86 many of those about me were reduced to mere skeletons through starvation, and, although they were helped as much as possible, several, it is to be feared, died not far from us. Some had eaten the skin covering of their bed, and were only saved by an occasional seal being killed and by the few lemmings they could catch under the snow. In one instance a case of what appeared to be economic hibernating was noted. Some distance from the Observatory a woman and her son were found closely huddled together in a house completely closed and not much larger than themselves. They said they had not had any food for some time, but expected friends in a few days. Leaving what food we had, we returned to the station, and extremely bad weather coming on some days afterwards, we had almost forgotten these people. Two weeks later we were reminded of them by an Eskimo having passed that way who said he had not seen them. Fearing they were dead, we went over with provisions, and much to our surprise found them, though little more than parcels of bones, perfectly well, and they declared they had lain there ever since. These people, with others, were soon stout and hearty when food became more plentiful.

In many of the narrow gravelly passes in the rocky hills, low walls were often noticed that had undoubtedly been built many years ago. These were in a straight line from one hill to another, and were usually nothing more than single stones about a foot high placed close to each other. Many conjectures as to their use were made, and, taking Ugaluk to one of these walls one day, he informed me that many years ago, when large numbers of Eskimo lived here, and wood was extremely scarce, some would bind sharp stones to their feet, and lying upon their backs behind these walls, others would drive the deer, which were then very numerous, and as the deer passed over the walls the hidden hunters would strike with their stone-tipped feet and would often kill many of them in this way. Regarding the scarcity of wood, it may be added that even now many Eskimo have not harpoons because they cannot procure a piece of wood large enough for a handle.

Having often heard of the dislike the Eskimo is believed to have to a white man exploring the graves of their dead, we determined to test this, and purposely went with several Eskimo, passing near where a number were buried. Here I stopped at one grave which had evidently long ago been visited by wolves or dogs, for the covering of stones had been dragged away and the bones were scattered in every direction. To my surprise the Eskimo looked on quite unconcernedly as I turned the skull and bones over with my stick, and, if anything, they seemed rather amused than otherwise. Suddenly I feigned an expression of fear, and while they looked at me made a bound forward, screaming as I fled. In a moment they were after me, screaming apparently in greatest terror. Soon stopping, however, I burst into laughter, and was immediately followed by all excepting the children, who evidently could not see the joke, nor would they return to the grave. During the remainder of my stay here we often examined other graves, but from a warm attachment for the dead, as well as for the living, not a bone was ever removed. F. F. PAYNE.

Meteorological Office, Toronto, Ont.

Movement of the Higher Atmosphere.

IF this question had been discussed previous to August 27, 1883, there would have been but one view expressed, and that would have been unanimous; namely, that the higher atmospheric layers have very little velocity, and if there is any motion it must necessarily be from the west toward the east. As it is universally admitted, even now, that the upper atmosphere has such a motion everywhere except in the equatorial regions, we need to give here some of the proofs that this law holds good for the latter region also.

1. A careful and elaborate theoretical discussion has shown the universality of the law. The merest outline of this discussion is as follows. The sun heats up the equatorial region more than the circles of latitude on either side, and this causes a bulging, so to speak, of the atmosphere over this region. These air particles will have a tendency to flow off toward the north and south; but a particle going from the equator continually reaches a region that is revolving less rapidly, so that its course will be deflected toward the east. This discussion loses a good deal of its force, however, when we consider how exceedingly tenuous the atmosphere must be at a height of twenty miles. The barometric pressure would be less than one inch, and any motion of air particles in such a space due to their gravity must be exceedingly slow, if they move at all. If we should inquire as to the probable amount of heaping up in the air from the increased heat at the equator, we would see that it must be exceedingly slight. Above the height of seven or eight miles the changes in the temperature would be nothing, as the sun's influence is entirely dissipated there; moreover, the difference in temperature between the equator and a point at 30° north latitude would be so slight that this heaping up would be highly problematical.

2. We find these theoretical computations and views amply borne out by a study of the motion and velocity of the highest clouds. For days at a time no motion at all can be perceived in these clouds at the equator, and whenever it is noted it is always toward the east and very slow. Mr. Abercromby seems to have observed a motion of clouds toward the west, but this must have been seen in clouds at a lower level, which would move westward in the lower trade-wind. The evidence regarding the motion of these highest cirrus clouds comes by special correspondence with physicists at Batavia, Mauritius, the West Indies, and the Philippines, and is conclusive as regards this question.

3. In many cases volcanoes have projected ashes to enormous heights in the atmosphere, both in the West Indies and in Java. Some of these ashes have been carried a comparatively short distance toward the west by the lower trade current, but others have also been borne many hundreds of miles farther eastward by the upper current. A good example of this is given in an eruption of Krakatoa in May, 1883, in which ashes were carried twelve hundred miles to the eastward.

4. One of the best proofs that can possibly be had of the direction and velocity of the higher atmospheric strata would be seen in the cloud left by a meteor in its passage through the sky. In a recent meteor that fell in Iowa, in a perfectly clear sky, there was a most excellent opportunity of studying this question. This meteor left a beautiful whitish cloud, which was carefully watched by at least two observers. One of them saw it perfectly stationary, a little to the east of the zenith, for more than an hour. The other saw it over two hours, and it appeared to gradually diffuse itself in the atmosphere. It is easy to see that any appreciable motion would have made itself plainly manifest in the long time during which this cloud was visible.

We see that both theory and observation give no uncertain sound on this question, and up to Aug. 27, 1883, this may have been regarded one of the best ascertained and established facts of meteorology. On this date there occurred one of the fiercest volcanic outbursts ever known, at Krakatoa in Java. On Aug. 28 and succeeding dates there were seen most beautiful sky colorings at various points on the equator to the westward of Krakatoa, each appearance being at a later date the farther west one went. An enthusiastic astronomer at once suggested that a current of eighty miles per hour had borne the ashes of Krakatoa westward, and that the sky-glows were caused by diffraction and reflection from these mechanically distributed ashes. This seems to have been an unfortunate invasion of an unknown field, and must result in disaster. Every effort has been put forth by astronomer and physicist to force such a current, but with two or three exceptions no meteorologist has accepted this view. We have already seen how untenable it must be. There are other insuperable objections to this hypothesis, but these against the velocity and direction of the current are the most serious.

The Krakatoaists have hailed with delight a certain theoretical computation advanced quite recently by Professor Ferrel, and it will be well to pass upon it at some length. Professor Ferrel first shows conclusively that the tendency of the upper layers must be toward the east, and then, referring to the sky-glows, he tries to

show that there might be a westward motion, by the following reasoning. If the Krakatoa outburst had occurred at a time of year when the temperature was uniform on either side of the equator, say in March and September, then the motion must have been toward the east, but, after March 21 and until June 21, the sun gradually heats up, relatively more and more, portions of the earth to the north of the equator. In consequence of this the bulging of the upper atmosphere does not occur at the equator so much as at circles of latitude farther north. As a result the motion of air particles becomes reversed, that is, toward the equator and not away from it. This would give the particles a tendency to move toward the west,—Q. E. D. This certainly seems like vicious reasoning. In the first place the phenomena of the sky-glows continued until the second week in September, or within ten days of the time when, according to Professor Ferrel, the heat of the sun would have been uniform on either side of the equator, and the motion of the higher strata must have been toward the east if at all. This consideration alone shows how untenable this reasoning is.

In the second place, let us inquire what the utmost effect can possibly be when the sun is at his farthest north. It should be noted that this heating effect is not directly upon the atmosphere, but the sun first heats the earth's surface, and that in turn the air above it, and so on. If we can find the air temperature at the earth at various latitudes we can reason from that as to the probable heating of the air at some height above the earth. It is quite difficult to determine the heat upon a complete circle of the equator, but, if we take the islands of the sea, we may make an approximation to the true value. The following table gives the temperature of the air at various points:—

Place.	Latitude.	Temperature (Fahrenheit).		
		March.	July.	August.
St. Thome	0° 20′ N.	78°	76°	76°
Batavia	6 S.	79	78	79
Singapore	1 17 N.	84	82	80
Mean	Equator.	80	79	78
St. Beneto	12 37 N.	80	72	72
Cape Verde Islands	14 54 N.	82	85	86
Jamaica	18 3 N.	70	75	74
Porto Rico	18 18 N.	77	82	82
Kanai	22 15 N.	70	76	77
Canary Islands	28 4 N.	63	69	70

It will be noticed at once that the high temperature of the Cape Verde Islands is due to the proximity of the African coast. It is also true that the exposure of the thermometer is not uniform at these localities. Making due allowance for all irregularities, however, we still find the most remarkable fact, that the air at the earth's surface in July and August is actually at a higher temperature on the equator than at a latitude of 23° where the sun may be supposed to be the hottest. This shows conclusively that this seeming heaping up of the air, to the north of the equator, owing to an increased heat from the sun's apparent motion northward in July, is entirely mythical; and the only effect that can possibly supervene upon the higher atmosphere must be a motion to the eastward, in all parts of the year, and in the equatorial regions as well as to the northward.

The question will arise, How can these remarkable sky-glows be accounted for? This question does not properly come into this discussion, but a partial answer may be given. The sky-glows were a marked intensification of ordinary sunset phenomena, which it is well known are due to moisture particles. In order that these glows might be seen at their best the following circumstances were necessary. (1) An abundance of moisture particles at great heights. (2) A clear sky. (3) An abundance of electricity in the air, which would cause the moisture particles to be repelled. We know that the occurrence of such an eruption as that at Krakatoa does set free an enormous amount of electricity. If any one of these were lacking the glow would diminish or disappear. It is known that the glows were of an intermittent character. That the action should have taken place at great velocity from east to west is not at all incredible. Whatever may have been the cause of these glows, we may be absolutely certain that they were not the effect of sun-light upon ashes or products of combustion mechanically distributed by a rapid current from east to west.

H. A. HAZEN.

Washington, D.C., Aug. 8.

BOOK-REVIEWS.

The Ethical Problem. By Dr. PAUL CARUS. Chicago, Open Court Pub. Co. 12°. 50 cents.

THIS pamphlet contains three lectures recently delivered before the Chicago Society for Ethical Culture, together with some preliminary matter on the same theme. Dr. Carus is deeply impressed with the importance of a new basis for ethics, the old traditional foundations having proved insufficient. He maintains, in opposition to many leaders of the ethical societies, that a correct theoretical basis of moral action is indispensable, a view with which we cordially agree; and he tells those societies plainly that, unless they supply such a basis, their movement will come to naught. "How can we," he asks, "have a common aim in the 'elevation of the moral life,' if we are not agreed upon what a moral life is, if our philosophical opinions about good and bad differ?" Accordingly he has prepared these lectures with the apparent purpose of furnishing a basis of ethics, but, we are sorry to say, without success. Indeed, he hardly makes a serious attempt to solve the problem; but contents himself with talking around it and about it, without ever coming to the point. He rejects all the theories of other men, theological, intuitional, utilitarian, and otherwise, and maintains that ethics must be based on "facts"; but what the true basis is he nowhere informs us. Indeed, we have seldom met with a more unsatisfactory treatment of the question at issue, and we cannot see that Dr. Carus has made any real advance from the position of the ethical societies.

AMONG THE PUBLISHERS.

D. C. HEATH & Co., Boston, have in press, to be published about Aug. 15, a new number in the series of Guides for Science Teaching, published under the auspices of the Boston Society of Natural History. The book is entitled "Insecta," and is written by Professor Hyatt, curator of the Natural History Society. It will be extensively illustrated with engravings from drawings made specially for the work.

—Scribner & Welford have the exclusive agency for America of the library edition of Moncure D. Conway's "Life of Hawthorne," published in England in the Great Writers series. This is printed on larger paper, and, in general, is gotten up more sumptuously than the twelvemo edition.

—Frank Vincent, the well-known traveller and author, "in recognition of his distinguished services to the literature of travel," has received from the Emperor of Austria the great gold medal for art, literature, and science. This is the second honor Mr. Vincent has received from Vienna, having, a few years ago, been elected a corresponding member of the Austria Geographical Society.

— Messrs. Longmans, Green & Co. have published a volume of short pieces by the late Richard Jefferies, entitled "Field and Hedgerow." It contains more than twenty essays, mostly on topics suggested by rural scenes and events; but for what purpose such works are written and read we do not know. There is nothing in the book but trifling descriptions of natural objects, written in a disagreeable style, with occasionally some brief remark on moral or artistic themes. We look in vain for any contribution to our knowledge of nature, either in its scientific or its esthetic aspect; while the author's remarks on higher themes are singularly vapid and profitless. It may be that somebody will derive either

amusement or instruction from the pages of this book, but we don't admire the mental equipment of the man who can do so.

—A readable account of the building up and washing away of the narrow sandy islands near Sandy Hook, Long Branch, and Cape May, illustrating similar action that is going on all along our eastern shores, will appear in the *Popular Science Monthly* for September. The article is by F. J. H. Merrill, and is entitled "Barrier Beaches of the Atlantic Coast."

—The Open Court Publishing Company have published "Three Lectures on the Science of Language," by F. Max Müller. They were originally delivered at the Oxford University extension meeting in 1889, and are, of course, of a somewhat elementary character. They give a brief summary of the leading facts about the nature of language, with remarks on the importance of studying it; and are specially designed to awaken an interest in the subject on the part of inquiring minds. The most interesting part of the book to scientific readers will be the passage in which the author discusses the relative merits of the two methods of classifying the races of men, by language and by physiological characteristics. He maintains that physiological classification has proved a failure, and that classification by language must be adopted, though with some reservations. Professor Müller reaffirms his theory of the origin of the Aryans in Central Asia, but without presenting anything new. The concluding paper in the book is a brief account of the earlier thinkers who have held Professor Müller's views as to the identity of language and thought. We may note in conclusion that the book is printed throughout in blue ink.

—D. C. Heath & Co., Boston, will publish in September a "Brief Course in the Elements of Chemistry," by James H. Shepard, professor of chemistry, South Dakota Agricultural College, and chemist to the United States Experiment Station. This book will be on the same plan as the author's "Elements of Inorganic Chemistry." It is not a fragmentary compilation, but gives the student a concise and comprehensive view of the main formulas of chemical science. The experiments are easily performed and bear directly upon the subjects under consideration, while the apparatus and chemicals required are as inexpensive as thorough work will permit. The book is well adapted to the needs of schools where the time is limited and where the teacher aims to do most of the work, but it will find a warm welcome in schools possessing working laboratories. The carbon compounds are tersely treated, thus giving the student an insight into the fundamentals of organic chemistry.

—The yield of gold in New South Wales in 1889, as shown by the "Annual Report of the Department of Mines," was larger than that for any year since 1883, amounting to over 182 million dollars.

—The United States Steamer "Thetis," Lieut Commander Stockton commanding, was detailed by the Navy Department to cruise, during the summer and autumn of 1889, in Behring Sea and the Arctic Ocean. During this cruise, in order to make its results as useful as possible, several of the officers on board the "Thetis" were directed to prepare reports upon subjects connected with the waters and regions visited by the ship, from their observation and from other reliable sources. One of these reports, by John W. Kelly, is on the ethnography of the Eskimos; and another, by Ensign Roger Wells, jr., is an Eskimo vocabulary, prepared almost entirely from information and material furnished by John W. Kelly, who spent three winters among the north-western Eskimos, and who has been engaged for seven years, at various times, in acquiring a knowledge of their language. The manuscripts of these two reports were presented to the Bureau of Education at Washington by Commander Stockton, to whose intelligent foresight the preparation of the reports was due. The Bureau, being charged with the supervision of education in Alaska, and the Commissioner of Education, W. T. Harris, appreciating the

value of all means or appliances that will tend to promote a better understanding of, and an easier communication with, the native races in that Territory, the reports have been published as Bureau of Education Circular of Information No. 2, 1890, under the title, "English-Eskimo and Eskimo-English Vocabularies, preceded by Ethnographical Memoranda concerning the Arctic Eskimos in Alaska and Siberia." The vocabulary is believed to be the most complete of its kind yet prepared. The book will be of great service, not only to the teachers, for whom it is primarily intended, but also to officers of the navy and of the revenue marine service, government officials in Alaska, and all others interested in the study of the Eskimo language.

To mend a piece of old Chinese or Japanese lacquer which has chipped away from the wood, first fill the space with white lead stiffened with copal varnish; when this is hard, polish it down to the general level of the surface; then, according to the nature of the ground, color with India ink or gild, or cover with brown varnish mixed with gold dust to imitate aventurine.

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SCIENCE

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A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
VOL. XVI. No. 394.

NEW YORK, AUGUST 22, 1890.

SINGLE COPIES, TEN CENTS.
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THE TIME-RELATIONS OF MENTAL PHENOMENA.

THE study of the time-relations of mental phenomena is important from several points of view: it serves as an index of mental complexity, giving the sanction of objective demonstration to the results of subjective observation; it indicates a mode of analysis of the simpler mental acts, as well as the relation of these laboratory products to the processes of daily life; it demonstrates the close inter-relation of psychological with physiological facts, an analysis of the former being indispensable to the right comprehension of the latter; it suggests means of lightening and shortening mental operations, and thus offers a mode of improving educational methods; and it promises in various directions to deepen and widen our knowledge of those processes by the complication and elaboration of which our mental life is so wonderfully built up. It is only within very recent years that this department of research has been cultivated; and it is natural that the results of different workers, involving variations in method and design, should show points of difference. In spite of these it seems possible to present a systematic sketch of what has been done, with due reference to the ultimate goal as well as to the many gaps still to be filled. It is with the object of furnishing such a general view that the following exposition has been attempted.

Rate of Nervous Impulses.

While it follows, as a very natural consequence of the modern view of the relation between body and mind, that mental processes, however simple, should occupy time, it must be remembered that the very opposite opinion has been held by serious thinkers. It has been argued as a proof of the immateriality of thought that its operations were out of relation to time, and the expression "quick as thought" has come to indicate a maximum of speed. It being established that so comparatively simple a process as sensation involves the passage of an impulse along nerve-fibres, it is plain that the rate of travelling of this impulse sets a limit to the time of the entire process, as well as of all more complicated mental operations in which sensations are involved. The physiologist Johannes Müller, writing in 1844, despaired of our ever being able to measure the time of so excessively rapid and short a movement; but before the close of the same decade, Helmholtz measured the rate in the nerve of the frog, finding it to be about 86 feet per second. Though somewhat greater in man, 110 feet per second, this movement is extremely slow compared with the velocity of light or even sound: indeed, it is only slightly faster than the fastest express train.

Müller writes: "We shall probably never secure the means of ascertaining the speed of nerve activity, because we lack the comparison of enormous distances from which the speed of a movement, in this respect analogous to light, could be calculated;" and again: "The time in which a sensation proceeds from the periphery to the brain and the spinal cord, and is followed by a re-action at the periphery by means of muscular contractions, is infinitely small and immeasurable." It is interesting to note how very crude were the conceptions of the older physiologists upon this point. Haller (1762) tells us of one who, following the view that the nervous impulse was a fluid, and its action analagous to that of the blood, found the "nerve tubes" of the heart to be 2,880 million times as narrow as the aorta, and concluded that the nervous impulse travelled proportionately faster than the blood, thus making its rate 57,600 million feet per second. Haller himself measured the maximum rapidity of short rhythmical movements, and (falsely), assuming that the impulse travelled to and from muscle and brain between each contraction, found an (accidentally not very erroneous) speed of 9,000 feet per second. The method introduced by Helmholtz, and improved by himself and others, consists in excising a muscle with a long stretch of nerve attached, and connecting the muscle with a lever, so that every contraction of it is registered upon the quickly moving surface of a revolving drum or a swinging pendulum. By electrically stimulating the nerve first at a point near to and then at a point far off from the muscle, two curves are recorded, the latter of which is found to leave the base line a trifle after the former. A tuning-fork writes its vibrations beneath these records, and enables us to measure how much later the second contraction began, while the distance travelled in this time is that between the two points of stimulation on the nerve. It has been attempted to measure this rate in man by having the subject re-act once to a stimulus applied to the foot, and again to a stimulus at the hip, or some point nearer the spinal cord, and counting the difference in time as due to the difference in length of nerve traversed. While the method is necessarily inaccurate, and other factors contribute to the difference in time, the majority of the determinations indicate a rate of between 30 and 40 metres (100 to 130 feet) per second. These determinations apply to sensory nerves: for the motor nerves of man, Helmholtz has found, by a method closely similar to that employed upon the frog, a rate of 110 feet per second. The most influential of the conditions affecting this rate is temperature: cold decreases and heat increases it, the extremes of variation being 30 to 90 metres. Under normal conditions it seems fair to regard the rate for both motor and sensory nerves of man as about 110 feet per second.

Analysis of Re-actions.

A great variety of actions may be viewed as responses to stimuli. There is a flash of light, and we wink; a burning cinder falls upon the hand, and we draw it away; a bell rings, and the engineer starts his train, or the servant opens the door, or we go down to dinner; the clock strikes, and we stop work, or go to meet an appointment. Again, in such an occupation as copying, every letter or word seen acts as a stimulus, to which the written letter or word is the

response; in piano playing, and the guidance of complicated machinery, we see more elaborate instances of similar processes. The printer distributing "pi," the post-office clerk sorting the mails, are illustrations of quick forms of re-action, in which the different letters of the alphabet or the different addresses of the mail matter act as the stimuli, and the placing them in their appropriate places follows as the response. In many games, such as tennis or cricket, the various ways in which the ball is seen to come to the striker are the stimuli, for each variation of which there is a precise and complex form of response in the mode of returning the ball. In military drill the various words of command are the stimuli, and the actions thus induced the responses; and such illustrations could be multiplied indefinitely. In all these actions the time-relations are more or less definite and important, but a useful study of them presupposes a careful and systematic analysis of the processes therein involved. We recognize that certain of the above actions are more complicated than others, and we must inquire in what this complication consists. In the process as usually presented the nature of the re-action depends upon the nature of the stimulus, a variation in the one being concomitant with a variation in the other. The piano player, seeing a certain mark on the page, strikes a certain key on the key-board, but strikes a different key if this mark be differently placed; the soldier varies his movement according to the word of command, and so on with most of the others. All such actions involve at least three processes: (1) the recognition of the sense impression, (2) the performance of the appropriate action, and (3) the association of the one with the other. The recognition involves the appreciation of the *presence* together with the appreciation of the *nature* of the sense-impression; and the movement involves the contraction of muscles together with the initiation of the impulse. We obtain the simplest form of re-action by limiting the stimulus to a single definite one, and having one and the same response irrespective of the nature of the stimulus. The subject expects the stimulus the nature of which he knows, and is ready to signal, by a simple movement agreed upon in advance, *merely* that the impression has been received. This we shall speak of as a "simple re-action." It occurs whenever a certain sense-impression is agreed upon as a signal for the execution of a simple movement. The time-keeper pressing the spring of the stop-watch, or the racer starting off as soon as the pistol is fired or the word is given, are instances of simple re-actions. It should be noted that the simplicity of the act refers primarily to the subject's fore-knowledge of what is to occur; the nature of the sense-impression, as of the motion, is known in advance, the association between the two being in the main artificial. Inasmuch as the more elaborate mental processes involve those of the simple re-action, our first step must be to determine its elements and their time-relations.

The Elements of a Simple Re-action.

The several elements of a simple re-action have been variously analyzed by different observers, but all recognize the *physiological* and the specially *psychological* portions of the process. The physiological time-elements include, (*a*) the time for the sense-organ to respond to an impression, i.e., to overcome its inertia; (*b*) the time for the passage of the impulse inward along nerves (and spinal cord), with the various delays whenever the impulse enters or passes through cells; (*c*) the return passage of the motor impulse from the brain to (spinal chord and) nerve and muscle; and (*d*) the time for the contraction of the muscle. The time thus left unaccounted for is that taken up by the psychological process, the transformation of the sensory into the motor impulse,—a process taking place in the brain, but as to the precise nature of which we have no definite information. The separate determination of each of the physiological factors enables us to find approximately the duration of the central process. As a sufficiently typical case we may accept the estimate of Cattell, that, in re-acting to a light by pressing the key with the finger, the time needed by the impulse to travel from eye to brain and from brain to spinal cord and finger is about 50σ;[1] the latent time in the muscle, during which it overcomes its inertia, is judged from experiments upon the frog to be about 5σ to 10σ; and experiment gives a value of 15σ to 20σ for stimulating the retina and initiating the impulse. As the entire re-action occupied about 150σ we conclude that in this case the physiological and the psychological portions of the process occupy about equal times. One may obtain a fair notion of the rate of these processes by the following simple experiment. A score or so of persons form a chain by joining hands, and at a given signal a certain member of the group sharply presses the hand of his neighbor, who in turn imparts the pressure as quickly as possible to *his* neighbor, and so on until the impression has gone the rounds. An outsider keeps the time (which may be done with sufficient accuracy by counting the ticks of a watch, usually fifths of a second) from the moment of giving the signal to start to the moment of receiving the signal from the last member of the group that the impression has been circulated. The entire time divided by the number of persons in the group (or better, by that number plus two to include the re-actions at starting and stopping) gives an average simple re-action-time, which, though long at first, is reduced after a little practice to a sixth or a seventh of a second. On this basis one may calculate that if a number of men, stretching out their arms and grasping one another's hands, were stationed in a straight line, it would take three minutes to send a message in the manner just described along a mile of this human telegraph.

(*a*) The inertia of sense-organs has been variously determined. One method measures how closely impressions may follow one another without fusing. The time thus measured is the minimum time during which the sense-organ may be stimulated and recover sufficiently to receive a second stimulation. This process thus includes something more than the one we desire to measure, and may perhaps be regarded as furnishing a maximum time of the sensory inertia. Here again various circumstances influence the determinations, the chief ones being the sense-organ in question and the clearness and intensity of the impression. Sectors of black and white upon a disc revolving in daylight at the rate of about 25 times a second fuse into a uniform gray, making the inertia of the retina under these conditions about 40σ. In weak light (moonlight) the time lengthens to about 100σ. The same experiment has been made with sectors of different colors, with the disc stationary and the light reflected from a rotating mirror, with a vibrating point of light; and, while all these variations somewhat affect the result, the majority of the determinations indicate a fusion at 30 to 40 impressions

[1] The sign σ indicates one one-thousandth of a second.

a second, or a duration of 33σ to 25σ. For sound, different observers have chosen different points for measurement. The slowest rate of impressions fusing into a musical sound has been fixed at between 30 and 40 per second; but Helmholtz has shown that the interference of sound-waves perceptible as beats does not escape detection when recurring as rapidly as 132 per second. For non-musical sounds, such as electric clicks, a still higher rate has been found. In touch we distinguish differences of feeling when impressions are rapid enough to fuse but not rapid enough to fuse perfectly. The smoothness of a polished surface is not obtained until the impressions occur 480 to 640 times a second (Valentin). For taste and smell the period, though not accurately determined, is undoubtedly very long. Here the time needed to reach the somewhat concealed sense-organs is considerable, and the chemical processes involved are relatively slow in action. The influence of the mode of activity of the sense-organ upon its period of stimulation is further illustrated in the long inertia period of the probably chemical action of vision compared with the short period of the mechanical senses of hearing and touch. This view is also supported by the fact that the period for the retina is shortened if the eye be directly stimulated electrically. Another mode of experimenting consists in applying a stimulus for the minimum time during which it can be recognized. The time thus measured will be shorter than the other, for it tells us only how long is needed for initiating the process of recognition sufficiently to have it continue to completion (probably after the stimulus ceases). This is indeed a surprisingly short time. Cattell and Sanford independently found that a color or a letter could be recognized when visible for only from 1σ to 5σ, while less recently Baxt recognized 6 to 7 letters when exposed for only 5σ. Others have calculated that the maximum effect of an impression is not reached until from 50σ to 150σ, but these determinations seem to involve some mental process of recognition. Whether or not some such process of recognition is involved is not quite clear. Unless specially prevented, the recognition will take place on the basis of the after-image, a few thousandths of a second being sufficient to initiate the process. By following the impression by a strong flash of light, and thus nullifying the after-image, Baxt found a longer time needed to recognize a more complicated impression. Within 10σ to 15σ, one letter; within 24σ, three letters; within 34σ, four letters, could be recognized. This only partially excludes the effect of the after-image, so that perhaps the results with complicated impressions are minimum "recognition times," and those with simple impressions "inertia times." Another method, that of Exner, is similar to the method of fusion. It consists in finding how closely two impressions, stimulating slightly different portions of the sense-organ, may follow one another and yet be recognized as successive. Optical impressions were so recognized when falling at an interval of 44σ on two points of the retina near the centre .011 millimetres apart, a longer time being necessary if the points are away from the centre of the retina. It seems probable that this process is more complicated than the one we are attempting to study. While the data thus at our disposal do not allow us to fix accurately the time of sensory inertia, the estimate provisionally accepted in the text cannot be far from the truth, being rather over than under estimated. The methods of measuring the rate of nervous impulses (*b*) and (*c*) have already been described. The inertia of the muscle and the time of its contraction are determined upon the same apparatus by observing how much after the shock is given the curve leaves the base-line.

Reflex, Automatic, and Voluntary Re-actions.

The term "re-action" as here used is not intended to include all responses to stimuli. The above instanced forms of re-actions present various grades of naturalness, utility, and habituation; that is, the association between motion and stimulus has by practice become more or less close and easy. Copying, for example, may become so entirely automatic that it runs on of itself without the need of renewed volitional effort. The actions recognized as reflex take place in spite of all volition. The re-actions here considered are limited to those requiring some degree of voluntary effort for their execution, though this may be almost indefinitely reduced by practice. The reflex act takes very much less time for its execution than the voluntary: the time for winking has been determined by Exner to be something over 50σ. In other words, it takes about three times as long to signal by a voluntary closure of the eye-lid that an impression has been received as to perform the same act reflexly when the eye is threatened. The utility of this quick action for the protection of the eye is evident; and other useful re-actions, such as those of flight and escape in timid animals, seem to be of a similar nature. The quick movements of defence when attacked, of regaining one's balance when slipping, are so immediately useful and so well inculcated in the organism as often to surprise us by their quickness. Most of these actions can also be performed voluntarily, but neither so well nor so quickly; it is therefore difficult to subject them to experiment. As already indicated, in the ordinary re-action there is little naturalness in the connection of stimulus and movement, the same type of movement being used for all. The experienced re-actor becomes accustomed to signal by the finger movement that the operation required of him has been accomplished, but hardly associates this movement with any particular stimulus.

It is perhaps well to add that the great saving of time in actions that have become automatic (such as is seen in the experienced piano player or post-office clerk as compared with the beginner), is in great part due to the increased facility of doing several things at once and not serially, a factor that enters only in a small degree into the simple reaction. The processes we should be most interested in measuring are those most closely approaching the operations of daily thought, so that the inference from experiment to practice shall be as direct as possible. This, however, it is difficult to do, because every-day mental processes do not present the simplicity of conditions required by experiment. Accordingly the method has been to study the simplest reactions, and then take into account the circumstances in which our usual mental operations differ from them.

[To be continued.] JOSEPH JASTROW.

LEGISLATION ON FOOD ADULTERATION.

THE adulteration of alimentary substances has been practised from the most ancient times, and numerous laws and regulations have been adopted in various countries to check and prohibit such sophistications.[1]

France has taken the lead in protecting consumers of food from adulterations, and in 1802 the Conseil de Salubrité was established in Paris. In England as well as in France, Germany, and other Continental countries, laws against the adulteration of individual articles, such as tea, coffee, beer, and wine have been passed since the middle ages. The first general act was not passed in England till 1860, and this was amended in 1872. However, they were found unsatisfactory, and the Sale of Food and Drugs Act was passed in 1875, and further amended in 1879 in the endeavor to obtain

[1] For copies of European laws on food adulteration see Report of the Commissioner of Internal Revenue for 1888 and for 1889; and for a summary of their leading features see Science, xiv., p. 308.

a workable law. This latter law is now in force, though the third and fourth sections of the act, relating to the mixing, coloring, staining, or powdering of any article of food so as to injure health, or in the case of drugs so as to injure their quality, are practically of no value and unenforced, because the fifth section provides that guilty knowledge is essential to the proof of the offence, and no prosecution, unless supported by very exceptional circumstances, would be successful under these sections. Sections 6 to 9 are the ones that are found workable, and provide that no person shall sell foods or drugs, with certain exceptions, to the prejudice of the purchaser; shall not abstract any constituents of food, and that compound foods or drugs must be in accordance with the demands of purchase, though with these sections again a large loop-hole for the escape of offenders is provided in section 8, which states that a legible descriptive notice that the article sold is a mixture exonerates the seller.

The amendment act passed in 1879 defined the meaning and effect of section 6, under which conflicting decisions had been given in England and Scotland. In fact, in the latter country the act had been inoperative since the decision by a majority of the judges of the High Court of Justiciary in Scotland that an official purchaser under section 13 of the act, buying samples for analysis and not for consumption, or at his own expense, could not be prejudiced by the purchase, and consequently that no offence would be committed under section 6. The court also held that the words "nature, substance, and quality," in section 6, could not be disjointed, and the article sold must be different in all three respects from the article demanded, and that as the statute was intended to strike only at foreign admixtures, the very nature of the substance must be altered, or the offence contemplated could not be committed (Davidson *v.* McLeod, Cowper's Reports, Vol. III., *p.* 538).

In the United States, on June 26, 1848, an act was passed by Congress to secure the purity of imported drugs, and is still in force. Its efficacy is directed principally towards Peruvian bark and opium.

The tea adulteration law was passed by Congress March 2, 1883, and on Aug. 2, 1886, the oleomargarine law was passed, defining butter and butter substitutes.

A law "to prevent the manufacture or sale of adulterated food or drugs in the District of Columbia," was passed by Congress in October, 1888. This law is modelled on the Sale of Food and Drugs Act, 1875, of Great Britain, sections 2, 3, 4, 5, 6, 7, 8, 9, 12, 17, 24, 25, and 27 (see Annual Report Commissioner Internal Revenue, 1888, p. cxcv), with certain necessary provisions of the English act omitted, especially those in regard to its mode of enforcement, the collection, identification, and payment for analysis of samples, etc. The law does not provide that the Commissioner of Internal Revenue shall enforce its provisions in procuring samples of food or drugs, that matter being delegated to "any purchaser," "any health officer, inspector of nuisances, or any food inspector," only requiring that the analysis shall be under his control "under such rules and regulations as may be prescribed by the Secretary of the Treasury." The officers specified in the act are not under the control of the Commissioner of Internal Revenue nor of the Secretary of the Treasury.

Our different State laws on the subject are most of them drawn up in a "follow-the-leader" style, under the popular but erroneous impression that any substance used as an adulterant of or a substitute for a food product is necessarily injurious to health, with the consequence that these laws are, with very few exceptions, merely dead letters.[1] In 1877 several of the State boards of health united, viz., those of New York, New Jersey, Massachusetts, and Michigan, and at their instance laws formulated on the English law were passed, and annual reports are now made by these boards on the results of the examinations of their chemists on the adulterations of foods and drugs practised in their several States. In the former State the law has proved a failure, because in an action brought to obtain "an injunction against the sale of certain Ping Suey teas it was held by the court, in refusing to grant the same, that, although the teas in question had been clearly shown to be adulterated with gypsum, Prussian blue, sand, etc., it was likewise necessary to prove that the effect of these admixtures was such as to constitute a serious danger to public health,"[2] In Massachusetts, however, the law has been enforced with vigor by the State Board of Health, and the yearly reports show a diminution in the percentage of adulteration of the samples submitted to analysis.

Owing to these faulty definitions and inadequate means of enforcement our State laws are inoperative, and until we have a national law to regulate the sale of adulterated articles of food, whereby the co-operation of State and national authorities could be secured in the enforcement of its provisions in regard to this class of fraud, the food sophisticater will pursue the even tenor of his way undisturbed. A national law would not apply to adulterated articles of food manufactured and sold in the State or Territory where produced, unless it should take the form of a revenue measure, imposing a tax upon the manufacturers of and dealers in such commodities.

On turning to some of the European Continental legislation on this subject we find that every dealer is held responsible for the quality of his merchandise, whether of foreign or domestic origin, and every food material must be sold under its true name; artificial products imitating a natural product must be properly labelled in a conspicuous and legible manner; all unwholesome foods are confiscated and destroyed without compensation to the owner; and adulterations generally are considered acts of fraud. Suitable police supervision and control are provided for the enforcement of these statutes; and, although these laws are somewhat of a paternal nature, they are much more effective than any we have.

The average American repudiates the idea of a paternal government supervision over his affairs, or any thing tainted with the idea. He may be willing to support, even to clamor for, a legislative measure to regulate the production or sale of a food product, provided it advances his particular business interests. He would, however, regard with apathy any general law that would guarantee to the public the liberty of purchasing pure food, with a reasonable certainty that they were not imposed upon in their purchases, if it was incumbent on him to take the necessary steps to execute its provisions by bringing samples for analysis, etc.

[1] For list of State laws on food adulteration see Report of the Commissioner of Internal Revenue, 1888, p. ccix.

[2] Battershall, Food Adulteration and its Detection, p. 8 (New York, 1887).

Let us consider what should be some of the leading provisions and definitions of such a proposed national law.

Definitions.

The word "food" should be defined as including every eatable, beverage, commodity, material or ingredient for food whatsoever, intended for consumption; and an article of food shall be deemed to be "adulterated"—

(1) If any substance has been added thereto which does not exist in the normal article or is only found there in an appreciably lower proportion;

(2) If any substance has been subtracted therefrom which is normally present in the article and which is not found in the abnormal article, or only there found in an appreciably lower proportion;

(3) If any substance has been substituted wholly or in part for the article;

(4) If it be an imitation, or sold under the name of another article; and

(5) If it consists wholly or in part, whether manufactured or not, of an animal or vegetable substance that is diseased, decomposed, putrid, or rotten: provided, that the addition to foods of any substance that increases their value; or the subtraction from foods of any inferior constituent, without deteriorating the resulting article; or the substitution of a superior for an inferior article, where there is no intention to defraud or to deceive, shall not be considered adulterations within the meaning of the act.

When substances known to be injurious to health (as those specified in the fifth definition above, and the mineral and organic salts and compounds enumerated below) are present in food, the manufacturer or dealer in whose possession or ownership such adulterated foods are found shall be liable to the confiscation and destruction by the proper officers of such adulterated articles without compensation for the goods, and want of knowledge in the possession of the manufacturer or dealer that the same was adulterated shall be no excuse. He shall also be liable to more or less heavy penalties, at the discretion of the court. If, on account of dealing in or consumption of articles spoiled in manufacture or transportation, or in those injurious to health, a death or even a severe sickness is caused by the same, the penalty shall be increased to imprisonment at hard labor for a term of years.

The following substances are known to be injurious to health when present in foods:[1] salts of antimony, arsenic, barium (except the sulphate), bismuth, cadmium, chromium, cobalt, copper, iron (the chloride and sulphate, though most iron salts are harmless), lead, magnesium, nickel, zinc, and some of the potassium and sodium salts; oxalic acid, picric acid, cocculus indicus (Indian berry, Levant nut), picrotoxine, gamboge, aniline, aloes, eosine, fuchsine and its immediate derivatives; coloring matters containing nitrous vapors, as naphthol yellow, victoria yellow; coloring matters prepared with di-azo compounds.

The following substances are known to produce more or less toxic effects, and whose presence in food is therefore harmful, and whose use is forbidden, under severe penalties, in most foreign countries having laws on the subject: salicylic acid and its salts, boracic acid and borax, glycerine, alum, beta-naphthol.

[1] From the regulations prescribed by the Secretary of the Treasury concerning analysis of foods and drugs in the District of Columbia under control of the Commissioner of Internal Revenue. Series 7, No. 15, U. S. Int. Rev. 1888, p. 16.

The following is a list of harmless coloring matters: Black,—Chinese black. Blues,—Berlin blue, indigo, litmus, Prussian blue, saffron blue, ultramarine. Brown,—caramel. Greens,—chlorophyl, as spinach juice, mixtures of yellow colors with blue. A mixture of Prussian blue, Berlin blue, and Persian berries gives a green rivalling in brilliancy Schweinfurt's green. Reds,—annotto, Brazil lac, carmine, carmine lac, cochineal, orseil, the juice of beets and red berries, such as cherries and currants, etc. Yellows,—Avignon berries, curcuma, fustel, marigold, Persian berries, quercitron, safflower, saffron, turmeric. Chalk, and the ochres.

The adulteration of food, as specified in the first four definitions, being aimed at the pocket and not at the health of the consumer, the taxes, fines, or penalties, as the case may be, provided for their violation should be such as to make dealing in them, unless clearly and distinctly labelled and branded, unprofitable. By thus compelling all manufacturers and dealers to wrap, label, and brand in a conspicuous manner all articles of food intended for consumption adulterated within the meaning of the first four definitions, the purchaser could readily recognize that such articles were of an inferior quality, and therefore should not be as expensive as the pure article. For instance, a mixture of beef stearine and cotton-seed oil has been placed on the market to compete with lard, having been sold as "refined or compound lard." These ingredients are as wholesome as the best kettle-rendered leaf lard, but being less costly, the mixture should be sold at a cheaper rate. As was said two years ago, "Food adulteration is carried on by manufacturers in the interest of pecuniary profit and gain, and they take pains to keep themselves well posted on the subject of cheap and harmless substitutes." "The public is cheated but not poisoned." (Annual Report Commissioner Internal Revenue, 1888, p. clxxxvi.)

All adulterated goods, when sold as such, should be so branded, with the word "Adulterated," or the words "This is a mixture," in letters printed in broad-faced type at least one inch square and affixed in a secure and conspicuous place, either by a label to the vessel containing the goods or on the goods themselves; and likewise such goods should be wrapped in paper or other covering with said words printed on both sides of the wrapper. Provision should be made for the character of the packing and quality of the vessel, either metal or glass, in which food products are put up. Acid foods will attack and dissolve the solder with which tin packages are closed, and such foods should be put up in glass or acid-proof vessels. The drawing of liquids like beer, vinegar, etc., intended for food, through lead or copper pipes should be prohibited, and iron or block-tin pipes only allowed.

Provision should be made in regard to the way-bills, bills of lading, etc., of railroad and transportation companies indicating distinctly the character of goods shipped.

The manufacture or sale of substances intended for the adulterations of articles of food, but which are themselves unadulterated, should be considered as the manufacture and sale of adulterated foods.

However perfect the definitions or severe the penalties for violations of the law may be, still, unless the means for enforcing its provisions are furnished, no good would come of it. The establishing and maintaining the force necessary for the due supervision and control, under a national law, of such adulterated foods should be suitably provided for, and the rules and regulations for their guidance should be vested in some responsible bureau officer, with the approval of the Secretary of the Department.

This force should be divided into two classes: (1) The inspectors, who would be assigned to certain districts, and should visit all manufactories of food products, including slaughter-houses and dairies, and the places of all dealers where articles of food intended for consumption are sold, displayed, or stored, procuring, by purchase or otherwise, samples for inspection or analysis. They should have the necessary police authority to detain, seize, or destroy adulterated articles of food wherever found, as now vested in most municipal sanitary police officers. (2) The analysts, under the control of a chief, would be required to make the necessary chemical and physical examinations of the samples of food collected by the inspectors, or submitted, under suitable regulations, by other parties. The duly verified certificate of an analyst, stating that the examination of the sample submitted shows it to be adulterated within the meaning of the act, shall be received as evidence of the fact in any proceedings taken against any person for violation of the law. The defendant, however, shall have the right to require the attendance of the analyst for the purpose of cross-examination.

Standards of strength, quality, or purity of different foods shall be fixed from time to time and prescribed by the Secretary of the Department for the guidance of the analysts.

Where samples of food products are received from the public at large they should be accompanied with an affidavit stating the facts in the case, and a small fee for the analysis of the same should be paid in advance.

The inspection of meat, fish, vegetables, fruit, and especially milk, should be done daily in any large city, and properly belongs to the health department of such city.

If such a law should take the form of a revenue measure many provisions of existing laws in regard to special taxes, stamps, brands, returns, notices, etc., could be made to apply, and very little increase in the force of the Internal Revenue Bureau would be needed.

If the manufacturers of adulterated goods paid special taxes at the rate of one dollar per month, wholesale dealers fifty cents per month, and retail dealers twenty cents for the same time, and a tax of one mill per pound were collected on every article of food adulterated within the meaning of the act, the revenue thus derived would not much more than cover the expense of enforcing such a law.

EDGAR RICHARDS.

NOTES AND NEWS.

AN ingenious contrivance has been recently adopted at the Hippodrome in Paris, with a view to producing scenic effects in the central oval space, without the spectators opposite being seen at the same time. *Nature* describes the contrivance as an elliptical screen of fine steel netting, which is let down in comparative darkness, so as to be about twelve feet in front of the benches. This is painted on the inner side with a representation of the Place du Vieux Marché at Rouen (the piece being "Jeanne d'Arc"), and, as it is strongly illuminated, at a given moment, from the centre, the light outside being low, a spectator at any point has an excellent view of the scene, while seeing nothing of the crowd beyond.

— James W. Queen, who founded the well-known house of James W. Queen & Co. of Philadelphia, died on July 12. He had been retired from business many years, so that his death will have no effect on the Philadelphia firm.

— In his recent thesis on the influence of the sea-shore on leaves M. Pierre Lesage shows by conclusive evidence, says *Nature*, that a marine habitat leads to a thickening of the leaves. The palissade-cells are more numerous and larger than in the leaves of the same plants grown inland. Apparently the sea-salt is the cause of this alteration, as plants cultivated in artificially salted soil yield thicker leaves. The observations of M. Lesage bear on some ninety species of plants which are in their natural state found near the sea (in Brittany) as well as inland.

—Professor Thomas F. Hunt, Assistant Agriculturist of the Illinois Experiment Station, reports a comparative feeding test between corn fodder and corn silage, the results of which are slightly in favor of the dry cured fodder. While the results of the experiments are somewhat contradictory, those which bear evidence of the greatest thoroughness agree in indicating that there is practically no difference between the feeding values of a given quantity of corn cured as ensilage and an equivalent quantity cured as dry fodder, provided equally good husbandry has been practised in both cases. Whether corn may be cured and preserved more economically by the one process or the other depends largely upon local circumstances and seasonal peculiarities.

— Commenting on an article on the influence of the moon on weather, by Dr. G. Meyer, *Nature* says, that, although such investigations have hitherto given a negative result, the author thought that with the materials furnished by synoptic charts he might eliminate local influences, and he gives tables extending over a number of years, which seem to show the influence of the moon in lowering the height of the barometer in the months of September to January, at the time of full moon, and in raising it during the first quarter. The Deutsche Seewarte, which communicates the article, points out that a similar result has been independently arrived at by Captain Seemann, one of the assistants of the institution. The same effect or any other is not perceptible in other months.

— The following facts, quoted by *Nature* from its French namesake *La Nature*, relate to exceptional seasons in past centuries. They were collected by M. Villard, of Valence, for France especially, and for Europe generally. In 1282 the winter was so mild that corn-flowers were sold in Paris in February. New wine was also drunk at Liége on Aug. 24. In 1408 the winter was so severe that nearly all the Paris bridges were carried away by the ice. Ink froze in the pen, although a fire was in the room. [A similar fact is quoted by Dove as occurring at Sebastopol on Dec. 13, 1855.] All the sea between Norway and Denmark was frozen. The summers of 1473 and 1474 were disastrously hot. In the winter of 1544–45 wine was frozen in barrels all over France. It was cut with hatchets and sold by the pound. In 1572–73 nearly all the rivers were frozen. The Rhone was traversed by carriages at various places. In 1585 the winter was very mild; corn was in ear at Easter, but the third week in May was extremely cold.

— The Belgian Legation at Mexico has recently reported to the Belgian Government on the subject of "guimbobo," known also as "angu," which is found in the State of Vera Cruz, a plant which should be included in the catagory of all the varieties of Mexican textiles. An American specialist has been appointed to examine and report upon the fibre-producing qualities of this plant. This gentleman has discovered that the guimbobo produces not only a fibre of very superior quality, but that it can be easily and cheaply cultivated; moreover, the fruit of the plant constitutes a nutritious food. According to the *Journal of the Society of Arts*, it appears from experiments that have already been made that the guimbobo differs essentially from the ramie, cotton, and hemp, as in the guimbobo the covering of the plant surrounds the fibre, and is not mixed up and interlaced with it;

this constitutes a decided economy, added to great facility, in extraction and utilization. The structure of the plant permits of the operations of separating and removing the bark being performed by machinery, while in the other fibrous plants these operations must be effected by hand, a system at the same time very costly, and only possible in countries where there is a large number of hands available and cheap. It is stated by the American specialist that he could construct a machine, costing no more than the ordinary machines used for cotton, and which could be used in the same manner. By this machine the fibre could be extracted and sold by the pound in the same way as cotton. Persons cultivating this plant would benefit in addition by the sale of the fruit, which is much esteemed in the temperate and tropical countries of the South, where the guimbobo grows luxuriantly, and almost without any care. The fibre of the guimbobo has a lustre similar to that of silk, and is undoubtedly finer and stronger, with a creamy color between white and straw color.

—A new gun, the invention of M. Giffard, the well-known French inventor, is attracting considerable attention among military men in Europe. As described in the London *Times*, the propulsive agent in this novel weapon is carbonic acid gas, compressed to a liquid condition, and capable of giving a pressure of five hundred pounds per square inch. The liquefied gas is contained in a metallic tubular reservoir about nine inches long, which is fixed under and in a line with the barrel of the gun, and which is conveniently grasped by the left hand in firing. Although containing an immense store of power, there does not appear to be any danger in a weapon thus equipped. In the first place, the reservoir is made of Siemens-Martin steel of the highest quality, so that a burst is considered hardly possible; and, in the second, should a flaw in the metal lead to a fracture, the gas would simply escape much in the same way that it does on the opening of a bottle of soda water. Then, the quality of the metal used for the gas receiver is such that it will stand rough usage without liability to fracture. It may be, and, indeed, has been, knocked greatly out of shape when full of gas without any prejudicial result arising, the gas having been afterwards used for discharging projectiles from the gun. The bullet is dropped into a small aperture at the rear end of the barrel, and by moving a small lever it is deposited in the breech chamber of the gun. The hammer is then placed at full cock and the trigger pulled. By the fall of the hammer a pin is struck which opens a valve at the rear of the liquefied gas reservoir, and permits the instantaneous escape of a sufficient volume of gas for one discharge. The bullet is thus ejected with a force proportionate to the impelling power of the charge, which can be increased or decreased at pleasure by a simple screw arrangement. In other words, the propelling power is completely under control, although, of course, this in practice is not left to the arbitrary will of the ordinary user, but will be fixed and definite, according to the character of the gun in which it is employed. The discharge of the gun is unaccompanied by any report, nor is there the least recoil or kick. On pulling the trigger there is a slight hiss or puff, followed by the noise of the impact of the bullet upon the iron target. The reservoir is very light, and when charged with liquefied carbonic acid gas, is capable, according to the size and calibre of the gun, of discharging from one hundred to five hundred consecutive shots at a stated cost of less than one penny. It is stated that there is no fear of any part of the gun or its mechanism becoming oxidized by the gas, and it is hardly necessary to add that there is neither smoke nor smell from the propellant. There is also no deterioration of the liquefied gas from storage or keeping. With regard to the rifle itself, with the exception of the tubular reservoir carried under the barrel, there is no material difference in appearance between the Giffard gun and an ordinary weapon of similar character.

— The success which has attended the use of arsenical sprays in combating the curculio upon the cherry and plum has led to its trial upon peach trees. London purple appears to have been most generally used in these trials, because this material has been strongly recommended during the last few years as preferable to Paris green. The advantages which London purple possesses over Paris green are its cheapness, and the fineness and lightness of the material, allowing it to remain longer in suspension in water. But the use of London purple upon the peach has often resulted in great injury to the foliage, and sometimes to the young shoots. The injuries in the Michigan peach orchards last year led Professor Cook, of the Michigan Agricultural Experiment Station, to experiment upon the influence of the arsenites upon foliage. He found that peach foliage is especially susceptible to injury, that London purple is more injurious to foliage than is Paris green, and that this is doubtless owing to the soluble arsenic which is quite abundant in London purple and almost absent in Paris green. The colored liquid left after the complete settling of the London purple was destructive to peach foliage. It appeared that greater injury occurred when the spraying was performed shortly before a rain, and that spraying soon after the foliage puts out is less harmful than when it is delayed a few days, or a few weeks. As a general result of the trials upon the peach, it was concluded that Paris green alone should be used, and that not stronger than one pound to three hundred gallons of water. Experiments in the same direction were performed at the Agricultural Experiment Station at Cornell University last year and this year, and the experiences of the two seasons coincide, so far as the experiments are comparable. The trials at Cornell, as given in the July Bulletin, show that peach foliage is very susceptible to arsenical poisons, and that London purple is much more injurious than Paris green. The young leaves are much less liable to injury than the full grown leaves. This is supposed to be due entirely to the waxy covering which is so abundant upon recent leaves and shoots. Late in the season, when the young and waxy growth is slight, nearly all the leaves will be killed by a mixture which would have had scarcely any effect when the tree is just pushing into growth in spring. Injury early in the season is less apparent, also, for the reason that growth of new leaves is so rapid that defoliation is obscured. In fact, the casual observer would not have noticed that the trees which shed their leaves in the earlier experiments had sustained the slightest injury, new leaves forming faster than injured leaves fell. Injury upon the leaf is first apparent in small and definite reddish-brown spots, which are visible upon both surfaces. The centre of the spot soon assumes a lighter color, and the tissue becomes dead and translucent. The edges of the leaf become discolored in like manner, and show a tendency to curl. A close observation discloses the fact that the discolorations take just the shape of the drops or streaks of liquid which lay upon the leaf. These leaves are at once distinguished from any which may suffer from fungous troubles by the absence of raised, puffed, or ragged borders about the spots, and by the presence of the scorched margins. Shoots are injured in the same manner as the leaves. Small bright red spots appear, and blotches mark the course of the liquid as it collected and ran down the stems. The whole shoot soon becomes abnormally red, as if its growth were arrested. Sometimes these shoots die outright, but they oftener survive. When the spraying is very copious, so that the liquid washes the foliage, half or more of the leaf may die outright without becoming much spotted. In such cases the injury is quickly apparent. The liquid runs down the stems freely, and they may suffer sooner than the leaves. In some of the trials, the death of the shoots caused the wilting of the foliage, and the leaves hung loosely for some days. Microscopic examination shows that the cell walls in the dead spots retain their shape, but the protoplasm is dry and shrivelled. The peach leaf has a very delicate structure, the epidermis being remarkably narrow, with thin-walled cells. This delicacy of structure appears to account for the peculiar susceptibility of the peach leaf to injury: the poison quickly permeates the tissue. Leaves injured by London purple were found, upon analysis, after thorough washing, to contain arsenic in the texture of the leaf, while analyses of leaves injured by Paris green showed no arsenic in the texture of the leaf. The poison in the latter case had acted from the surface of the leaf. It is apparent that London purple is the more injurious because of its soluble arsenic. The arsenic in London purple is in the form of a normal arsenite of calcium, which substance comprises about 72 per cent of the whole compound, and over 50 per cent of it, or nearly 40 per cent of the London purple, is quickly soluble in water.

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

ORIGIN AND CHARACTER OF THE SAHARA.

AT the annual meeting of the Scottish Meteorological Society on July 12, Dr. John Murray read an interesting paper, a summary of which is given in the August Proceedings of the Royal Geographical Society. In his paper, Dr. Murray treated of the meteorological conditions of desert regions, with special reference to the Sahara, the northern border of which he had recently visited. He pointed out that the arid regions of the world are distributed in two bands, north and south of the equator. They are all inland drainage areas, or areas where the streams have no connection with the sea. They are also regions where evaporation is in excess of precipitation, for if the latter were in excess the water would rise till it could flow into the sea, as in the case of the great lake district of North America, and the area would no longer be one of inland drainage. The largest of the deserts, the Sahara, is about three and a half million square miles in area, and the area of all the deserts of the world together is about 11,500,000 square miles That is to say, over one-fifth of the land of the world has no outlet for drainage to the sea, and in all that area evaporation is greater than precipitation. These areas correspond very closely with the regions of the world where the rainfall is less than ten inches annually. In no place in the world can there be got such enormous changes of temperature as in the deserts. In the Sahara the temperature sometimes falls from 100° during the day to the freezing point during the night. This arises from the great dryness of the atmosphere, and from the radiation that takes place from the burning soil after the sun has set. These inland drainage areas correspond very much in their barometric phenomena. In all desert regions during summer all winds blow in to them. In winter the reverse takes place, the winds flow out of them; and that holds good both for the northern and the southern hemispheres. This leads to the low rainfall, for the great majority of these regions are more or less bounded by high hills. The winds come into the deserts over these hills, and the vapor is precipitated from the atmosphere by the hills, with the result that when the winds reach the interior regions there is nothing left to be deposited. If there are not hills all round any desert area, then, as in the case of Northern Asia, the winds pass from a colder to a warmer climate, and as they get to warmer regions they are able to contain more vapor, and none is precipitated.

Dr. Murray then proceeded to give an account of his own views and impressions as to the Sahara. During the "Challenger" expedition he and his companions had found in the bed of the Atlantic for a long distance west of the African coast opposite the Sahara, and in the bed of the Indian Ocean to the south of Australia, small grains of red quartz sand; and they had found scarcely a trace of such in the sea-bed in any other part of the world. He suspected this quartz sand had been blown out from the Sahara in the one case, and from the Australian desert in the other. On his journey southward through Algeria, he found the country as far as Tougourt converted into a garden by means of artesian wells. At Tougourt the real sandy part of the desert began, and he made excursions into it, with that town as his headquarters. He exhibited to the meeting a specimen of the sand, of a light yellowish-brown color, and exceedingly fine in the grains. There were, he said, a good many clay particles in it, and the quartz particles, which were also numerous, were identical with those they had got in the bottom of the Atlantic. There was no doubt that the winds from the desert carried the sand a long way out to sea.

He had also examined the region geologically, and found that the formation of the rocks was entirely that of fresh water, and of quaternary date. The great majority of geographers and geologists have expressed the belief that the whole of the Sahara is an old sea-bed, but in his opinion, it has never as a whole been covered by the sea since Cretaceous or Devonian times; and no part of it has been covered by the ocean since Tertiary times. The whole question about the discovery of shells seems to rest upon one common species being found very rarely in one region of the desert. Owing to recent researches, the opinion as to the Sahara being an old sea bottom is very likely to disappear from our textbooks. He considers that the features of the region have been produced by atmospheric conditions. The sand is the product of the disintegration of the rocks *in situ*. The existing rock is not far below the surface, and by digging down to it, the hard sandy particles are found embedded in the stone. The sun shone on the rocks, and they expanded. The sudden cooling at night broke them up, the wind carried away the smaller particles, and so continually the rocks are being disintegrated by means of changes other than water, although water perhaps in times past played a greater rôle there than it does now. There is a range of hills in the desert, seven thousand feet high, and for three months in the year their summits are covered with snow. Descending the hills are old river-courses, some of great length. Much of the region, he considers, has once been a large fresh-water lake. Speaking of the commercial aspect of the Sahara, he said it was difficult to go there without becoming enthusiastic about it. There seems to be no limit to the amount of water that is to be got by sinking artesian wells. The cultivation of palms is extending to an enormous extent, and the French expect to carry on their railway to Tougourt, at present nearly a week's journey from Algeria, in the next few years.

BULLETIN No. 7, July, 1890, just received from the Virginia Agricultural Experiment Station, treats of tests with varieties of strawberries made the present season, giving full discussion, with critical descriptive notes of forty-nine varieties; also full tabular statements showing yields, earliness, quality, etc.

HEALTH MATTERS.

Sea Air for Phthisis.

IN reviewing a recent work by Dr. Remondino, president of the Board of Health of San Diego, Cal., *The Lancet* says: "Dr. Remondino discusses at considerable length the influence of marine climates upon phthisis, and sums up strongly in their favor. This is a return to the views of Laennec and most of the older authorities—a doctrine thrown somewhat undeservedly into the shade by the good results obtained at some of the high altitude sanatoria. In forming a rational creed upon this difficult question, we must beware of the fallacy that lurks under most sweeping generalizations, and we must never shut our eyes to any well-authenticated facts. The good results obtained at Davos, Görbersdorf, Denver, Bogota, and such like elevated sanatoria, must not make us rush to the fallacious generalization that high altitudes are a specific for phthisis, nor should such facts cause us to ignore for a moment the excellent effects that often attend a sea voyage or a residence at a marine sanatorium. We have to recognize that good results may attend either method, that general rules lead only to confusion, and that our business is not to exalt the high altitudes over the sea voyage and the marine resort, or *vice versa*, but to seek as patiently as possible to determine the indications and the contra-indications for and against each type of climatic treatment. Dr. Remondino is emphatic in his opinion that atmospheric moisture, as compared with soil moisture, has no influence in generating phthisis, a view in which we quite concur.

"As regards the results of the treatment of phthisis at San Diego, Dr. Remondino speaks very confidently. He informs us that the banks, stores, and business houses are largely manned by cured consumptives; and that of the physicians, dentists, lawyers, and clergymen, it is safe to say that eight out of ten resorted to California for their health. Of 258 deaths registered from phthisis during ten years at San Diego only nine cases were born in California. In estimating the value of this fact we must remember that we are dealing with a new country, mainly peopled by immigrants. Dr. Remondino thinks cases of hemoptysis do very well in California; he has also seen apparently wonderful results in laryngeal phthisis, in which affection his experience would appear unusually fortunate.

"If past experience warns us that roseate accounts of new sanatoria must be received with much reserve, there seems every reason to admit that southern California is one of the most favored regions of the world, that its climate possesses a conjunction of advantages rarely to be found, and that the country presents many attractions for the tourist, settler, or invalid."

Death from Tight Lacing.

Happily the practice of tight lacing, though still a fruitful source of illness, does not now occupy a foremost place among the recognized causes of death. The fact that it does occasionally stand in this position, however, should be noted by those foolish persons whose false taste and vanity have made them the suffering devotees of a custom so injurious. It should be remembered also, that, whatever may be said of the more evident effects, the indirect consequences of thus tightly girding the body can not be exactly estimated. They can not be but hurtful. The veriest novice in anatomy understands how by this process almost every important organ is subjected to cramping pressure, its functions interfered with, and its relations to other structures so altered as to render it, even if it were itself competent, a positive source of danger to them. Chief among the disorders thus induced are those which concern the circulation, and it is to the laboring incapacity of a heart thus imprisoned and impeded, both as regards the outflow and return of blood, that such disastrous consequences as occurred not long ago in a Berlin theatre must be attributed. According to *The Lancet*, one of the actresses, who had taken part in an evening performance, and then seemed to be perfectly well, was found next morning dead in bed. Subsequent examination of the body showed that death was due to syncope, and this was attributed to tight lacing, which the deceased had practised in an extreme degree. As regards the persons immediately affected, the warning conveyed by this incident is obvious.

Restriction and Prevention of Diphtheria.

In a recent communication to the Health Officer of Detroit, concerning disinfection by the fumes of burning sulphur, the secretary of the Michigan State Board of Health calls attention to some important facts bearing on the subject. Excluding Detroit and Grand Rapids (the data from which cannot be profitably included with the data from the smaller places), the official reports prove, beyond a reasonable doubt, that isolation and disinfection do restrict diphtheria. In those outbreaks in which isolation and disinfection were neglected, there were on the average over fourteen cases, with nearly three deaths, to an outbreak; while in those in which isolation and disinfection were enforced, there was an average of only a little over two cases, with only about six-tenths of one death, to each outbreak. It must be remembered that these figures relate to instances in which at least one case of diphtheria had already occurred in the community, and that occasionally several cases occur at once, on the start. The method of disinfection referred to is that recommended by the State Board; namely, burning three pounds of sulphur for every thousand cubic feet of air space in a room, infected articles being loosely spread out; and, because of movement of infected articles from the sick-room and from one room to another, all rooms in the house are disinfected, together with all contents. Experiments by Pasteur and M. Roux, with the co-operation of Dujardin-Beaumetz, prove two important points in this connection: (1) that the burning of two pounds of sulphur per thousand cubic feet of air-space is not always certainly effective, and (2) that three pounds is effective. This applies to a closed room; if there are openings through which the fumes may pass, more sulphur is required.

Disappearance of Small-pox in Germany.

Under the law of Germany making vaccination compulsory and providing for re-vaccination at stated periods of life, says the *Sanitary Inspector*, small pox is almost completely disappearing from the German Empire. A late official report states that in 1888 only 110 deaths from small-pox occured in the whole empire, and that this number is 58 fewer than occurred in 1887, and 87 fewer than in 1886. Of the 110 deaths, 88, or about four fifths of the whole number, occurred in those parts of the empire immediately bordering other countries not well protected by vaccination, and in which there is constant intercourse between the vaccinated and the unvaccinated sides of the boundary. More than one-third of all the deaths occurred in the Prussian privince of Posen. Comparing the small-pox death-rate of the large cities of other countries with that of the larger cities of Germany, it was 136 times as great in the cities of Austria, 30 times as great in those of Hungary, 16 times as great in those of England, 24 times as great in those of Belgium, and twice as great in those of Switzerland, as in the German cities.

Treatment of Snake-Bites.

In a paper in the *Revue Scientifique* describing his recent researches and experiments regarding the bites of poisonous snakes, Professor Kaufmann advises that in the treatment of a bite the injured limb should be tightly bound above the bite as quickly as possible, with a handkerchief or any other available constrictor, and that then a 1-to-2 solution of chromic acid should be injected deep into the wound, making several similar injections in the neighborhood of the wound. If these directions are carefully followed, the poison will be destroyed before being absorbed. If there is already much swelling of the wound, more injections should be made in various parts of the swelling, which should then be manipulated to bring the acid thoroughly into contact with the poison. The swelling should then be freely lanced and as much as possible of the fluid squeezed out. The skin should be washed with the chromic acid solution, followed by the application of compresses saturated with the solution. If the swelling returns, these procedures should be repeated. This local treatment should be supplemented by the internal administration of alcoholic stimulants and aqua ammonia. Professor Kaufmann, however, strongly condemns the use of large quantities of alcohol, which, he thinks, paralyze and depress the nervous system.

Surgeon Parke on Vaccination.

At the great banquet of welcome given in London to Surgeon Parke, he briefly referred to the inestimable benefit of vaccination. Before the expedition started for Africa, says the *Medical News*, he vaccinated nearly every man in Stanley's little army, with the result that when they were surrounded by small-pox there were only four cases among the members of the expedition, none of which proved fatal. But among the camp-followers and irregulars, who had not been vaccinated, small-pox was almost universal, and large numbers of them died. It is probable that without the precaution of vaccination the expedition would never have had strength to complete the march across Africa.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Wind-Systems.

THE remarks on the general wind-systems of the globe on page 80 of *Science* for Aug. 8 are interesting. I have been securing from various mathematicians and meteorologists numerical statements of the deflective force of the earth's rotation on moving bodies on its surface. No two such statements thus far secured agree with each other or correspond with the deflection of air-currents actually depicted on the weather maps. As I understand the communication above mentioned, there is substantial agreement on the basis of the reasonings there presented that there is neither eastward nor westward movement of the atmosphere at latitude 35° 16′. It is true that the south Atlantic anti-cyclone is located at nearly this latitude, and is quite persistent. But the other anti-cyclones of the northern hemisphere, with reference to which alone we have full information, are not located at this latitude. On the contrary, they form a belt, not about the geographical pole, but about a point situated twenty degrees from it at longitude 96° west. In consequence of this displacement the centre of this belt is found as far north as 55° in the eastern hemisphere. Moreover, the separate anti-cyclones constituting it have a decided tendency to move eastward. Even the south Atlantic anti-cyclone pushes eastward not unfrequently at all seasons, and either fragments are detached from it or it moves bodily across Europe. At certain seasons this easterly movement of anti-cyclones is rapid, and at times appears to be independent of surrounding cyclones. This would seem to be a feature of the circulation of the atmosphere that is not consistent with the assumption that there is absence of eastward or westward movement at latitude 35° 16′. M. A. VEEDER.

Lyons, N.Y., Aug. 13.

On the Lack of the Distance-Sense in Prairie-Dogs.

SEVERAL individuals of various ages under observation at Cornell University walked off chairs, tables, and window-sills with nearly equal absence of hesitation. This deficiency of a faculty which is so conspicuous with squirrels and some other rodents may be ascribed to the nature of their usual habitat, a plain, in which the only sharp inequalities may be the burrows and mounds of their own making.

One adult female, however, has manifested an immunity from the ill effects of falls which is not easily accounted for, and may be worthy of record. When about three years old it fell down a shaft upon the wooden top of an elevator 6.6 metres (21.6 feet) below. For a few minutes it remained nearly motionless, as if stunned, but gradually revived and completely recovered. On the 14th of July, 1890, at the age of 7½ it fell an equal distance from a window-sill upon a broad granite step. On looking out, it could not be seen; closer inspection revealed a single spot of blood, and, at the foot of the steps, a hole into which, presumably, it had crept, and from which, four days later, it was coaxed, a little wild but apparently uninjured. These two survivals are notable in view of the peculiarly solid and "chunky" form of the animal, and the improbability that such accidents should occur in a wild state. By allowing it to fall into water or upon soft material it is intended to observe the attitude during descent. The sense of distance may be cultivated. The brains of prairie-dogs will be compared with those of squirrels.

The subject of this note is 30 centimetres (12 inches) long, the tail contributing 6 centimetres; it is fat, and weighs 755 grams (26.6 ounces); the writer does not know the ordinary size and weight. It is friendly to all, but recognizes familiar voices and hands; is practically omnivorous, drinks milk, and has killed and devoured a ruffed grouse. Like all of the species, to a sudden sound, the fall of an object, a rap on the door, the voice, a cough, and particularly a sneeze, it responds by erecting the body and barking. The nervous mechanism involved seems to be largely reflex, rapidly exhausted, but nearly or quite uncontrollable; indeed, there is reason to believe that the second fall was due to an unguarded erection of the body at the edge of the window-sill; the bark was heard at the striking of a large clock in the same tower, and when the occupant of the room turned the dog had disappeared. Do any other animals display this reflex responsiveness to sounds?

As a slight contribution to the mechanism of dreams it may be added that the second fall and disappearance occurred during the writer's absence; that he is much attached to the prairie-dog, and promptly sent directions to search for it, urging that the steps should be removed if necessary; and that the following night he dreamed of superintending the demolition of McGraw Hall; finally that neither to him nor to any others connected with the university did their appear any incongruity in the destruction of a fifty-thousand-dollar stone building for the recovery of a prairie-dog. BURT G. WILDER, M.D.

Ithaca, N.Y., Aug. 16.

Ballooning of Spiders.

MCCOOK'S great work on "American Spiders," whilst properly rejecting some proposed explanations of their aeronautics, does not offer any better explanation, but merely speaks of ascending air-currents, and gives important observations which show that the point of departure is an exposed rail fence or other elevated place in sunshine. I would suggest that the explanation is to be found in the fact that sunshine on such departure-platforms causes an upward current by heating and rarifying the air, and so starts the flight; and when (often after several vain attempts) the gossamer-line is at length sent aloft, the sunshine on the line litself will warm and rarify the surrounding lamina of air, and so increase the ascending current as to carry upwards both the filament and the suspended spider. For this last point I am indebted to Professor C. S. Young.

If these suggestions be good, then the interesting aeronautics may be expected to occur only during sunshine, and the term "ballooning" will not be entirely metaphorical, save in the sense that the rarified gas is outside instead of inside the silk mechanism. F. MACLOSKIE.

Princeton College, N.J., Aug. 18.

AMONG THE PUBLISHERS.

THE index for the September number of the *Chautauquan* shows the following inviting subjects: "On the Nature and Value of Folk Lore," by L. J. Vance; "Sacred Trees," by Dr. Ferd. Adalb. Junker von Langegg; "The Supreme Court of the United States," by Eugene L. Didier; "Experiment Stations: What is an Investigation?" by Byron D. Halsted, Sc.D.; and "Modern Magic and its Explanation," by Marcus Benjamin, Ph.D.

—E. & F. N. Spon announce a treatise on "Water Supply, Drainage, and Sanitary Appliances of Residences," including lifting machinery, and lighting and cooking apparatus, by Frederick Colyer; "Sewage Disposal," being fourteen years' experience in works of intermittent downward filtration, separately and in combination with surface irrigation, with notes on the practice and results of sewage farming, by J. Bailey Denton (second edi-

tion, with additions); and "Drainage with Regard to Health, and Modes of Disposal of Town Sewage," by George J. C. Broom, F.G.S.

—Messrs. D. Appleton & Co. announce that the third volume of McMaster's "History of the People of the United States" is now well advanced, and will be published probably in the course of the winter. It will be remembered that the second volume closes with the negotiations regarding the Louisiana purchase. In the new volume, which will contain eight chapters, Professor McMaster begins with the debate in the House regarding the constitutionality of the Louisiana purchase, and he closes the volume with a discussion of the political and economic effects of the War of 1812.

—Ginn & Co., publishers, announce as in preparation "Allen and Greenough's Ovid," revised edition, edited by Harold N. Fowler, Ph.D., instructor in Latin in Phillips Exeter Academy; with a vocabulary by James B. Greenough, professor of Latin in Harvard University, which is intended to be of the same character as vocabularies to Virgil, Cæsar, etc., by the same author. The editor believes that the poems of Ovid are, as regards both style and subject matter, better adapted than those of Virgil to serve as an introduction to the study of Latin poetry. He therefore intends to furnish the book with copious notes suited to the needs of young students, which will be supplemented by grammar references and an introduction on the life and works of Ovid and on mythology. The selections are taken mainly from the "Metamorphoses," and are chosen with a view to making the study of Latin interesting. The value of the book will be greatly enhanced by the addition of the vocabulary.

—Among the books in press announced by the J. B. Lippincott Company are "The Distribution of Wealth," by Rufus Cope; "Hermetic Philosophy," by J. S. McDonald, author of "Vital Philosophy," etc.; "The German Soldier in the Wars of the United States," by J. G. Rosengarten (second edition, revised and enlarged); "Regional Anatomy in its Relation to Medicine and Surgery," by George McClellan, M.D., illustrated from photographs taken by the author of his own dissections, expressly designed and prepared for this work, and colored by him after nature (this last-named work is to be sold by subscription only); and "Historic Note-Book," by the Rev. E. Cobham Brewer, LL.D., Trinity College, Cambridge, author of "The Reader's Hand-Book," "Dictionary of Phrase and Fable," etc.

—In the early summer of 1889 a circular-letter was issued to the working entomologists of the country, offering prizes for essays containing original investigations regarding methods of destroying the mosquito and the house-fly. The object of this effort was to bring about an intelligent discussion of the question, What natural enemies of these irritating insects may be easily and efficiently arrayed against them? The voracious and harmless dragon-fly, of which our country supplies so many beautiful varieties, was especially designated as possessing qualities that made it a promising subject for careful investigation. The plan of destruction thus sought for is that so commonly observed in operation upon a grand scale in nature, where individual species and whole families are swept out of existence through its operation. The questions formulated in the circular-letter were widely discussed. Newspapers and other periodicals treated them from a hundred standpoints; a volume could be filled with articles relating to the subject published in this country and in Europe. The most valuable results were, as expected, those submitted by the scientific experts especially appealed to. The essays that they presented are the outgrowth of long years spent in rearing insects, studying their transformations and habits, and of extensive special reading. These essays were found so full of valuable scientific and popular information that the recommendation of the distinguished judges acting under the terms of the circular-letter, to place them in a printed form before the public, has been complied with in the volume "Dragon-Flies versus Mosquitoes," published by D. Appleton & Company. An article contributed by Dr. McCook to the *North American Review* is reproduced with especial view to his observations on mosquito-catching spiders. Captain Macauley, of the United States Army, furnishes an interesting chapter of his experience among the dragon-flies and mosquitoes of the upper Missouri. The book is illustrated with colored and other plates.

—Among other articles, the *Westminster Review* for August contains the following: "Mr. Stanley's New Book;" "Lunacy Law Reform;" "Life in Achill and Aran," by Michael MacDonagh; "Cremation at Milan," by H. Sutherland Edwards; "Divorce: Does Scripture Forbid It?" by A. P. Richards; and "The New Educational Code: Will it Work?" by Joseph J. Davies. The *Scottish Review* for the same month contains "Canada and the United States," by J. G. Bourinot; "Traces of a Non-Aryan Element in the Celtic Family," by Professor J. Rhys; "Bikelas on Scotland," by J. S. Blackie; "The Interpretation of the Critical Philosophy;" "Oriental Myths and Christian Parallels," by Florence Layard; "Odd Foods," by Alfred J. H. Crespi; "The Cession of Heligoland," by Andrew T. Sibbald. In the *Nineteenth Century* for August are to be found "The Value of Africa: a Reply to Sir John Pope Hennessy," by H. H. Johnston; "On the Rim of the Desert," by E. N. Buxton; "The Power of Suggestion," by A. B. McHardy; "Primitive Natural History," by Geo. J. Romanes; "The American Silver Bubble," by Robert Giffen. The *Contemporary Review* this month has an illustrated article on "Christ among the Doctors," and an article on "Women and the Universities." Other articles are "How British Colonies Got Responsible Government," by Sir C. G. Duffy; "The National Home Reading Union and its Prospects," by J. C. Collins; "The Shetland Isles in the Birds'-Nesting Season," by T. Digby Pigett; "Illustrated Journalism," by Carmichael Thomas; "The Prehistoric Races of Italy," by Canon Isaac Taylor; "The Nihilisms and Socialisms of the World," by J. Page Hopps; "The Organization of Unskilled Labor," by R. Spence Watson; "A Defence of University Lectures," by Professor William Knight; and "Britain Fin de Siègle," by Frederick Greenwood. The *Fortnightly* has articles on "The Latest Discoveries in Hypnotism," by Dr. J. Luys; "The Stronghold of the Sphakiotes," by James D. Bourchier; "Ethics and Politics," by Sir Rowland Blennerhassett; "Labor Disputes in America," by Dr. W. H. S. Aubrey; "The Educational Outlook," by the Rev. J. R. Diggle; "Armenia and the Armenian People," by E. B. Lanin; and "War in the Future," by Col. W. W. Knollys.

—Bulletin No. 22 of the United States Department of Agriculture comprises the reports of the field agents of the Division of Entomology which were necessarily omitted from the annual report. Although Mr. Coquillett has reported upon several phases of his work, the Bulletin gives only the portion relating to the experiments which he made in the destruction of the red scale of California (*Aspidiotus aurantii* Maskell) by the use of washes. A portion of his report relating to experiments with gas treatment for this scale insect, resulting in the great cheapening of the use of this process, was printed in *Insect Life* for January and February, 1890. Another section of his report, relating to the attempted colonization of the insects preying upon *Icerya purchasi*, imported by Mr. Koebele from Australia, was published in part in *Insect Life* for October, 1889, and the remainder is reserved for future use. The experiments with washes were undertaken with a view of presenting a practical illustration of their utility to the fruit-growers of southern California, who had apparently ignored the previous results obtained and published in the reports for 1886 and 1887. The red scale was particularly chosen on account of its importance as a pest, and for the further reason that the fluted scale seems at present to require no further experimentation, since the vedalia is overcoming it so rapidly. Professor Osborn, we learn from the Bulletin, has taken up the study of insects injurious to grasses, in addition to his regular work upon the insect parasites of domestic animals, and reports upon the leaf-hoppers injuring forage plants. This is a comparatively new and important field of investigation. Professor Webster continues his studies of grain insects, and reports upon certain points connected with the economy of a few well-known pests. Miss Murtfeldt sends in a general report upon the insects of the season in eastern Missouri, brings out a number of interesting facts, and gives the life history of a beetle injuring spinach, and also the histories of two interesting saw-flies. Mr. Koebele during the

latter part of the season did considerable field work, and reports upon a number of injurious species. Perhaps the most interesting feature of his report is his work upon the enemies of the codling moth in California. He has reared four entirely new parasites of this species, two of which are primary and two secondary. The egg parasite seems to be a very important feature in the life of the codling moth on the Pacific coast, and we know from previous experience with egg-parasites of the same genus that they are capable of very rapid development, and are consequently very beneficial insects where they attack injurious species. Professor Bruner treats of the insects of the year, and enters upon the consideration of insects detrimental to the growth of young trees on tree claims in Nebraska and other portions of the West, an important subject which has not before received treatment.

—No. 12 of Blakiston's (Philadelphia) series of "Quiz-Compends" has just been published. These compends are based on popular text-books and the lectures of prominent professors, and are kept constantly revised, so that they represent the present state of the subjects upon which they treat. The one now before us, No. 12, "A Compend of Equine Anatomy and Physiology," by Professor William R. Ballou, supplies for students of veterinary anatomy and physiology a work which will answer their needs not only as a text-book, but also for work in the dissecting-room. In its preparation the standard work of Chauveau has been followed in the main, though the works of Strangeways, Gray, and Quain have also been consulted. The work is illustrated with twenty nine engravings, selected for the purpose from Chauveau's "Comparative Anatomy."

—Bulletin No. 24, from the Agricultural Experiment Station, Madison, Wis., is entitled "A New Method for the Estimation of Fat in Milk, Especially Adapted to Creameries and Cheese Factories." Dr. S. M. Babcock, chemist of the station, has devised a method for determining the amount of fat in milk, which appears to be simple, economical, and accurate. Briefly described the method is as follows. A carefully measured sample of milk is placed in a test bottle having a long narrow neck. Next, an equal volume of sulphuric acid is added, and the bottle is placed in a wheel, which is revolved horizontally from six hundred to eight hundred times per minute, for about six minutes. At the end of this time the fat of the milk set free by the acid has risen to the top of the liquid. Hot water is then poured into the bottle, partly filling the neck. Upon again whirling for a couple of minutes the fat will rise through the water into the neck, in a long column, where it is easily read off by graduations on the neck. By this method the fat in skim milk, buttermilk, whey, cream, and even cheese can be determined.

—Messrs. Ginn & Co. have published "The Nine Worlds," by Mary E. Litchfield, being stories from the Norse mythology. The stories are based upon the Eddas, but the authoress has also relied much upon the best German and other authorities. Unfortunately, she has, as she admits in her preface, drawn largely upon her own imagination, the first story in the book having no foundation except a few lines of poetry, which really do not support it at all. Hence, though she tells us much about the mythology of the Norsemen, her book cannot be relied upon as an authority. The leading character in most of the myths is Loki, the spirit of evil, while Odin, Thor, and various other gods and giants, are brought prominently forward. The slaying of Baldur, who represents the summer sun, and the carrying off of Iduna, the goddess of spring, are among the most interesting myths. Miss Litchfield gives in an introduction an account of the Norse cosmology, and in an appendix a glossary of the names and attributes of the various gods and other personages. The book will interest those who like tales of the marvellous, and will impart some general information about the Norse mythology.

—The "Summary of the Seventh Annual Report of the Bureau of Statistics of Labor of the State of New York" contains matter of interest to economists. It is devoted to an account of the various strikes, lock-outs, and boycotts that have occurred in the State during the past five years, with statistical tables showing the

Publications received at Editor's Office, July 21–Aug. 9.

AMERICAN Association for the Advancement of Science, Proceedings of, Thirty-eighth Meeting, August, 1889. Salem, Permanent Secretary. 496 p. 8°.
ANNUAL Report of the Chief Signal Officer of the Army to the Secretary of War, for the year 1889. Parts I and II. Washington, Government. 389 + 165 p. 8°.
ANNUAL Report of the Department of Mines of New South Wales, 1889. Sydney, Government. 253 p. f°.
BUNYAN, John. Pilgrim's Progress. (Classics for Children.) Ed. by D. H. Montgomery. Boston, Ginn. 119 p. 12°. 35 cents.
HARDY, A. S. Elements of the Differential and Integral Calculus. Boston, Ginn. 239 p. 8°. $1.65.
INTERNATIONAL Marine Conference, 1889, Proceedings of. Vols. I, II, and III. Washington, Government. 814 + 680 + 502 p. 8°.
MIAMI Horticulturist. Vol. 1. No. 1. *m.* Bradford, Ohio, M. Cassel. 8 p. 4°. 25 cents per year.
MONTGOMERY, D. H. Leading Facts of American History. Boston, Ginn. 412 p. 12°. $1.10.
MULLER, F. Max. Three Lectures on the Science of Language. Chicago, Open Court Publ. Co. 112 p. 8°. 75 cents.

causes and results of the strikes and the costs to both parties. In giving the number of strikes, each establishment is reckoned separately, so that if a general strike occurred affecting a hundred establishments it counts in the report as a hundred strikes. On this basis it appears that during the five years from 1885 to 1889 the number of strikes in the State was 9,384, of which 5,866 were successful and 3,468 unsuccessful, while 50 were pending at the time of making up the report. The loss to the laborers is set down at over $8,000,000, and the gain in wages for five years at upwards of $18,000,000. Commissioner Peck thinks that there is no likelihood of a discontinuance of strikes, and believes that on the whole they are beneficial to the laborers. He shows, however, that there is a strong disposition on the part of most labor organizations to exhaust all peaceful means of settling difficulties before striking, and quotes largely to this effect from their rules and regulations. The feeling of many employers about labor disputes is well expressed in a remark by one of their number which is quoted in the report: "When they have us down they give it to us; and when we have them down we give it to them" (p. 51). The commissioner believes, however, that "large-souled employers have no hard feelings against employees who protect themselves in an open and honorable manner."

— A very admirable scheme for schools, colleges and others to get text books is the one recently started by W. B. Harison of 6 Clinton Place, New York City. Mr. Harison, during the past ten or twelve years, while a member of a wholesale school-book house, has made a study of the best means of meeting the demands of institutions using a variety of text books; and his system, the result of experience, insures accuracy, promptness and economy. Being thoroughly acquainted with the good points of the many educational publications, Mr. Harison is able to purchase intelligently and advise on the many questions arising from time to time; and as his system is based upon a commission it is his interest to act for his customers to their best advantage. Schools and colleges which purchase their own supplies will find it to their interest to write to him.

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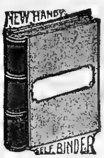

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EIGHTH YEAR.
VOL. XVI. No. 395.

NEW YORK, AUGUST 29, 1890.

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THE TIME-RELATIONS OF MENTAL PHENOMENA.

[Continued from p. 101.]

Conditions Affecting Simple Re-action Times.

REFERRING to the accompanying table for a general view of the time-relations of simple re-actions, we may pass at once to the topic of greatest interest, viz., the influences by which they are quickened or retarded. These may be considered as (*A*) objective, or affecting the conditions of the experiment, and (*B*) subjective, affecting the attitude of the re-actor.

(*A*, 1) *The Nature of the Impression*. The distinctive characteristics of a simple re-action being in the attitude of the re-actor, it would seem that its time could be little affected by the nature of the impression. The motor signalling process is the same, the connection between the impression and movement is about equally artificial in all cases, so that the chief variability must be in the time needed for receiving the impression. For the different senses this time is different. Taking the general average of all the observations accessible to me, I find, for hearing, 138σ; for touch, 148σ; for sight, 185σ. This order is quite constant with the different observers, the long time of visual re-actions being referable to the long inertia period of that sense, as well as to the small perceptive area of the retina, necessitating a precise accommodation, — a condition not always supplied in the above experiments. This view is strengthened by the shortening in the re-action time (by 36σ for Exner, by 24σ for v. Wittich) when the eye is stimulated electrically. In re-acting to a temperature sensation, care must be taken not to re-act to the sensation of contact with the skin. Where this has been done it has been found that the re-action to the sensations of temperature is longer than to contact, and that the re-action to heat is longer than to cold. Thus, Vintschgau and Steinach re-act to a pressure on various points of the head in 109σ, to a sensation of cold in 135σ, of heat in 146σ, similar values for various points of the hand being 121σ, 188σ, 209σ. The researches of Goldscheider agree with these in the main, but make the difference between the re action times to heat and to cold much greater. The senses of taste and smell clearly illustrate the effect of the kind of stimulation, for here the relative inaccessibility of the sense organs and the slowly acting chemical processes involved lead to a long re-action time. Though experimentation is difficult and uncertain in these senses, we may cite for smell the results of Moldenhauer on the odors of various oils, centring about 300σ (oil of roses 273σ, camphor 321σ, musk 319σ, ether 255σ, etc.), and for taste, of Hönigschmied, who re-acts to various tastes on the tip of the

Table of Simple Re-action Times.

No.	Nature of Sense-impression.	Nature of Re-action.	Observer.	Time.	Remarks.
I	Visual (various kinds)	Finger.	Average of many	185	
II	Tactile " "	"	" "	148	
III	Auditory " "	"	" "	139	
IV	Temperature (cold)	"	Vintschgau & Steinach Av.	161	Average of all parts of body.
V	" (warm)	"	" "	177	
VI	Light of intensity I.	"	Berger & Cattell Av.	210	The intensity in terms of a common unit were as 7, 23, 123, 315, 1000, the two highest intensities not being determinable.
VII	" " II.	"	" "	184	
VIII	" " III.	"	" "	174	
IX	" " IV.	"	" "	170	
X	" " V.	"	" "	169	
XI	" " VI.	"	" "	156	
XII	" " VII.	"	" "	148	
XIII	Touch (electric shock)	"	Exner.	139	On the hand.
XIV	" " "	"	"	175	On the foot.
XV	Sound (low)	"	Wundt.	175	*With* preparatory signal.
XVI	" "	"	"	266	*Without* " "
XVII	Sound	"	Berger & Cattell Av.	124	Preparatory signal at regular intervals.
XVIII	"	"	" "	165	Preparatory signal irregularly varied within 15 seconds.
XIX	Sound { Average of weak and loud sound	"	Wundt.	121	Intensity of sound known.
XX	" " "	"	"	203	Intensity of sound unknown.
XXI	Sound	"	Münsterberg.	162	Attention directed to sensation.
XXII	"	"	"	120	" " movement.
XXIII	Touch (electric shock in forearm).	By opening and closing jaw. Av.	Orchansky.	155	Normal.
XXIV	" " " "	"	"	105	8 minutes after taking 60 ccm. of rum.
XXV	" " " "	"	"	225	30 " " " " "

tongue in 182σ, though other subjects require about 300σ. On the back of the tongue the time is much longer, and it varies for different tastes, being longest for bitter, shortest for salt, and about equal for sweet and sour. Within the same sense the re-action time will vary according to the nature and place of the stimulus. The above cited differences for tastes and smells show this; and for different visual impressions, for different tones, for contact at different parts of the body, different results have been obtained, referable to slight variations in sensibility, length of nerve traversed, clearness of the impression, and the like. These minor differences are not easily established, but the following may be cited. Exner re-acts to an electric shock on the hand in 132σ, on the forehead in 137σ, on the foot in 175σ; v. Wittich re-acts to a point on the back of the finger in a longer time than to one on the front, 144σ and 156σ, and regards the difference as due to a difference of sensibility. Hall and Kries clearly show that the re-action to a point looked at in indirect vision is longer than to one in direct vision, 195σ and 235σ, and find further differences according as the point is above or below, inside or outside, the retinal centre. A high tone is re-acted to more quickly than a low one, and so on.

It is easier to demonstrate the influence of (2) *the intensity of the stimulus*. Within limits, intense stimuli affect sense-organs more quickly than weak ones, and, roughly speaking, an increase in the intensity of the stimulus is concomitant with a decrease in the re-action time. According to Wundt, the noise of a hammer falling respectively from heights of 1, 4, 8, and 16 millimetres was re-acted to in 217σ, 146σ, 132σ, and 135σ, and the sound of a ball falling from heights of 2, 5, 25, and 55 centimetres in 176σ, 161σ, 159σ, and 94σ respectively. Exner varied the length and therefore the brilliancy of an electric spark from 0.5 to 7 millimetres and obtained a steadily decreasing re-action time of 158σ to 123σ. More complete are the observations of Berger and Cattell, who found that as the light increased from 7 to 23, to 123, to 315, to 1,000, and to two greater but not determinable degrees of intensity (as compared with a small unit of light), the re-action times fell (average of two observers) from 210σ to 184σ, to 174σ, to 170σ, to 169σ, to 156σ, to 148σ. For sound, as the ball fell from heights of 60, 160, 300, and 560 millimetres the re-action times were 151σ, 146σ, 127σ, and 123σ. For electrical touch excitations, re-actions to four grades of stimuli separated by equally perceptible differences were made (average of two observers) in 173σ, 159σ, 145σ, and 145σ. Wundt regards the difference in re-action times of the different senses as in part referable to differences in intensity, and, when re-acting to just perceptible intensities of sensation in various senses, finds about the same long time for each, 330σ.

3. *The Mode of Re-action.* The various movements by which we may signal that a sensation has been received may differ in the ease of their execution, in the length of nerve traversed, as well as in the naturalness of association with the impression. Such differences, however, seem to be small; when once the movement is understood and anticipated, the difference in the times of its execution is slight. Thus, Münsterberg found, in testing the re-action of each of the five fingers, that while at first the thumb and little finger re-acted more slowly than the others, after some practice the times of all were substantially the same. Féré, however, has some results suggesting that the fingers making the strongest movements re-act in the shortest times. Very interesting, too, is the experiment of Ewald in which the stimulus, an electric shock, is given to the finger in the very key by which the re-action is signalled, the re-action consisting in the very natural movement of drawing the finger away. Under these circumstances he found a brief and constant time of 90σ. Both Vintschgau and Cattell have compared the time of re-acting by closing a key with the finger and by speaking a word, and find the vocal method the longer by about 16σ and 30σ respectively. Differences in re-acting from the two sides of the body have been observed by some, the right side showing the shorter re-action; but this difference can hardly be considered as constant. Orchansky has shown in one case that the movements of inhibition take about the same time as those of excitation of a muscle, and it would be possible to study the relative ease of various movements by this method. A practical example is furnished by the commands of military drill, the words, "carry," "present," etc., announcing the mode of re-action for the performance of which the following word, "arms," is the signal.

(*B*) We pass next to the more important *subjective* factors, referring in the main to the *expectation* and the *attention*. While nothing has been definitely said upon this point, the implication has been that the subject tries his utmost to re-act as quickly as possible, and that he knows the nature of the experiment. While the influences now to be discussed seem to be general in their effect, making the nervous system at one time a better and again a worse re-acting apparatus, they may, in certain respects, be subjected to a more definite analysis. We begin with (1) *the subject's fore-knowledge of what is to take place.* We may anticipate the outcome of experimentation on this point by formulating the law that the more definite the fore-knowledge of the subject the quicker the re-action. Apparently there is a process that must be gone through with in each re-action, and the better prepared the subject is for this,—that is, the more of this process gone through with before the giving of the stimulus,—the less of it falls within the measured interval. The precise nature of this process is a difficult and much discussed problem. It may be sufficient to note at present that the re-action to a certain stimulus cannot but imply in some sense the distinction of that stimulus from the many others by which we are constantly surrounded. If the subject be re-acting to a visual impression, he will probably not press the key should a noise occur in the room or something accidentally come in contact with his hand. To re-act to a visual impression thus implies the distinction of that from other impressions. It implies the identification of the expected with the existing impression. Just as we recognize an appearance in the heavens or under the microscope more readily when we know where and what to look for, or as we immediately recognize an almost forgotten acquaintance when expecting him, though at a chance meeting we might have passed him without recognition, so we re-act to an impression most quickly when it is most definitely expected, with regard to its nature, its time and place of appearance, and the like. This expectation may be more or less specific, and an interesting series of experiments consist

in varying the fore-knowledge of the subject while still leaving it definite enough to call the result a simple re-action. (*a*) We may leave the precise *time* of the appearance of the stimulus undetermined. This may be done by experimenting with and without a preparatory signal, preceding the stimulus by a regular interval. Wundt re-acted to the sound of a ball falling from a height of 25 centimetres in 76σ with a preparatory signal, but in 253σ if no such signal preceded; to a ball falling five centimetres, in 175σ in the first case, and 266σ in the second. The time between the signal and stimulus is here regular, and the most favorable time seems to be about two seconds. Lange found the time with an interval of two seconds less than with one of one or three seconds. If the interval be irregularly varied within two seconds the effect is hardly noticeable, but if irregularly varied within fifteen seconds the time is increased (Cattell). With a normal re-action to sight of 149σ and to sound of 124σ, the re-action to sight with the interval varying within two seconds was 148σ; when varying within fifteen seconds, to sight, 174σ, to sound, 165σ (average of two observers). (*b*) If the time and nature of the stimulus be known, but its *intensity* be varied, the time is increased. When re-acting to a uniform change between a feeble and a loud sound, the re-action time to the former was 127σ, to the latter, 116σ; but when these changes were made in an irregular and unexpected manner the times were lengthened to 208σ and 198σ.

Similarly the attention may be prevented from being effectually directed to the making of the re-action by a variety of circumstances. Some of these we may group under the term (2) *distraction*. By a constant noise or other means we may be creating a stimulus to which the attention is involuntarily drawn, and thus withdrawn from the process of re-action. Wundt re-acted to a sound of mean intensity in 189σ, to a strong sound in 158σ, but when a disturbing sound was going on in the room these re-actions required 313σ and 203σ. On the other hand, with Cattell, when in good practice, so that the re-action became almost automatic, the effect of a disturbing sound both upon sight and sound re-actions was insignificant,—normal for sight, 149σ, with disturbing noise, 155σ; normal for sound, 124σ, with disturbing noise, 124σ. It is quite probable that what acts as a disturbance to one person hardly affects another. In some individuals the re-action time seems to be extremely sensitive to any mental disturbance. One of Obersteiner's subjects, with an average re-action time of about 100σ, requires 142σ to re-act when music is heard, and another's re-action time is lengthened by 100σ when talking is going on in the room.

A more general and thorough form of distraction may be effected by imposing a task requiring distinct mental effort at the same time that the re-action is to take place. Thus Cattell attempted to add 17 consecutively to a series of numbers, and found that re-actions taken while this was going on were longer by 28σ (average of two observers). All such effects seem to be much more marked when the re action in question is new than when it has become familiar and partly automatic. The disturbance seems to act by delaying the association between stimulus and movement.

(3) We have now to notice a distinction which, though but recently brought to light (by N. Lange, 1888), is of fundamental importance. A re-action may be made in two ways. In the one form of re-action the attention is directed to the expected impression: it is identified as the expected impression, and thereupon is initiated the impulse resulting in the re-acting movement. The several processes are performed serially, the attention being concentrated upon the sensory part of the process. In the other form of re-action the attention is directed to the movement: the impulse is ready, and is set off by the appearance of the signal almost automatically, the identification of the actual with the expected impression being omitted. The first is spoken of as the "complete" or "sensory" mode of re-action, the second as the "shortened" or "motor" form. In the experiments of Lange the simple sensory re-action time to a sound (average of three persons) was 227σ, motor 123σ; to a visual impression (average of two persons), sensory 290σ, motor 113σ; to a tactile impression (one person), sensory 213σ, motor 108σ. These differences, however, seem to be extreme. Münsterberg finds for sound, sensory 162σ, motor 120σ. A further characteristic of the motor form of re-action is that its average variation is smaller, i.e., the process is more regular; and that false re-actions occur, either anticipations of stimulus or re-actions to some accidental disturbance. The distinction becomes still more important when the re-action is not simple but complex, and we will return to it later. The distinction is important as aiding in the explanation of individual differences, as well as of the path of practice. The somewhat conflicting results obtained before this distinction was taken into account might very well be due to the fact that the one observer re-acted in the one way and the other in the other. Thus the re-action times of Kries and Auerbach are motor; for they are brief, false re-actions occur, and it is noted that the simple re-actions following re-actions involving distinctions were longer by 41σ and 31σ than before,—a change probably due to a return to a partially sensory mode of re-action. Again, there are doubtless transitional modes between the two, and there are reasons for believing that the path of practice is from the sensory to the motor form of re-action.

The influences that remain to be discussed may be considered under the heads of "practice," "fatigue," "individual differences," and "abnormal variations." (4) *Practice.* As just noticed, the effect of practice is intimately connected with the mode of re-action. It is noticed by almost all writers, but the extent to which it influences the time is very various. The observations make it probable that the effect of practice is most marked at first, and that when once the initial stages are over, the effect of continued practice is small. It is greatest in those persons whose time is longest at first, and seems most influential in acts that are complicated and lie somewhat beyond the realm of daily experience.

When the action is once thoroughly learned, an interval of disuse seems not to affect the time seriously. After not re-acting for three months, Cattell found no essential difference in the time. On the other hand, with some there is a slight newness on beginning each day's work, making the first re-actions of a series rather long (Trautscholdt).

(5) A similar statement may be made of *fatigue:* it has greatest effect upon the complicated, less thoroughly learned processes, and varies with the individual and the mode of re action. With an automatic simple process its effect is very slow to appear (Cattell). It may enter at any stage of the process, sensory, motor, or central; but the last seems to

be the most serious. It appears as a difficulty in keeping one's attention upon the experiment, and thus lengthens the time, and especially the average variation of the experiments. By fatigue is meant the fatigue brought about by the experimenting itself. The time is also affected by general fatigue preceding the experiment. Some individuals are extremely sensitive to influences of this kind.

(6) *Individual Variations.* The fact here to be investigated is the general one that different persons require different times for the performance of the same operations. The difficulty of drilling a company of men to act in concert, whether in military drill or otherwise, springs in part from this difference. It was from this point of view, too, that the time of mental processes was first studied. So long ago as 1795 Maskelyne, the astronomer royal, discharged his assistant because the latter recorded the transit of a star across the wire of the telescope half a second or more later than he himself. Some twenty-five years later Bessel, another astronomer, had his attention called to the point, and upon investigation established the fact that no two observers recorded such transits at precisely the same time. The difference in time between any two observers was usually expressed as an equation, and hence the term "personal equation," which, though strictly applicable only to the differences so found, has assumed a much wider meaning. The individual differences become greater as the process to be performed increases in complexity, and this explains in part why the personal equations as determined by the complicated eye and ear method were so large: with the simpler method of electrical record these differences are much reduced. Besides the differences due to practice and the mode of re-action, there are a large number of minor sources of variation, which as yet are not sufficiently understood to justify a correlation of quick or slow re-action times with definite individual qualities. We may, however, note (*a*) that the time is longer in children than in adults, as has been shown, amongst others, by Binet, who found that children from $3\frac{1}{2}$ to 7 years re-acted in from 440σ to 66σ, when adults required but 140σ. In the very old the time is longer than in the prime of life. Under the influence of mental or physical fatigue, worry, or slight indisposition, the time has been increased. Obersteiner, Vintschgau, Goldscheider, and others, have incidentally observed these effects, showing an increase of 30σ to 40σ. These variations are related to others, shading over into the abnormal. Under this head may be considered (7) *the action of drugs and re-action times in the insane.* Several of the earlier experimenters made a few observations concerning the effect of drugs. Exner found quite a marked lengthening of the time after drinking wine. Vintschgau and Dietl found that the effect of coffee was to decrease and of morphium to increase the time for a considerable period. The more elaborate researches of Kraepelin show that the effect of amyl, ether, and chloroform is a sudden lengthening of the re-action times, reaching a maximum in a very few minutes, and followed by a rather long period of times slightly shorter than the normal. If a strong dose of the drug be used the lengthening is more considerable and the secondary shortening slighter. Thus Kraepelin, whose normal re-action was 183σ, after a strong inhalation of ether re-acted in 298σ, and in the period of shortening in 170σ; while with a light narcosis the maximum re-action was 223σ, and the shortened re-action 150σ. The effect of alcohol, however, is a brief period of shortened times followed by a long period of lengthened times. This is also found by Orchansky, who, with a normal re-action of 155σ, re-acts in 105σ eight minutes after taking a dose of alcohol, and in 225σ after thirty minutes. The observations of Warren do not yield equally positive results, but do not conflict with those of Kraepelin. Changes in the extent of the average variation have also been observed. On what psychological factors these differences depend it is difficult to say, but the subjective feelings accompanying the lengthened times are a difficulty in keeping the attention upon the matter in hand, and an unwillingness to exert one's self. The evidence afforded by the action of drugs upon these processes is important as indicating the dependence of the re-actions upon physiological conditions. A change of re-action times in insanity has been frequently observed, but the field for individual variation is here very large. It seems probable that in most forms of mental disease, and particularly in melancholia, there is a considerable lengthening of the re-action time, amounting in extreme cases to one-half or three-quarters of a second. In the excited forms of disease, such as mania, a shortening has been observed. Obersteiner cites a case of general paralysis in the incipient stages of which the time was 166σ, in a more advanced stage 281σ, in a most advanced stage 451σ. Stanley Hall has found a marked shortening of the time in the hypnotic condition, but his result is not corroborated by others.

Methods of Experimentation.

The chief requisite in these experiments is an apparatus for accurately measuring small intervals of time. The earliest method, still in use, records the vibrations of a tuning-fork upon the quickly-moving smoked surface of a rotating drum, and beneath this the moment of giving the signal and making the response. If a fork making one hundred vibrations per second be used, whole hundredths can be directly counted and smaller fractions estimated. Wundt has constructed a more accurate and specialized instrument in which a fork making five hundred vibrations per second is used. A very much simplified form of apparatus has been devised by Obersteiner, in which the slide holding the record is moved by hand, and the movement of re-action draws the fork off the record; and by Bowditch, in which the fork itself carries the record, and the signal and re-action are indicated by a shifting of the writing point. In the astronomical records clock-work takes the place of a tuning-fork. The objection to these methods is that they necessitate tedious counting of curves. If the rate of the rotating-apparatus is very uniform and frequently tested, one may substitute measuring for counting, but the most convenient apparatus for the purpose is the Hipp chronoscope. This instrument contains a fine clock-work, set in motion by releasing a spring and running for about half a minute. The hands of the two dials, the one indicating tenths and the other thousandths of a second, do not move until drawn away from a set of cogs by the opening or closure of a magnetic circuit, and are stopped again in the same way. By making the usual arrangement whereby the production of the stimulus sets the hands in motion and the re-acting movement brings them to a stand-still, we can read off directly the interval of the re-action time. Unless we can afford to sacrifice accuracy for convenience, a means of controlling the chronoscope is indispensable. This may be done by timing the fall of a ball from a given height and comparing it with theoretical time. In the apparatus for this purpose supplied with the chronoscope the ball is mechanically released, and the mode of making the circuit is equally defective, so that

the error of the control apparatus is probably greater than that of the chronoscope. To obviate this difficulty I make use of a ball held in position by a magnet, and falling from any height up to seven feet, upon the arm of a well-balanced lever, thus securing an instantaneous release. By setting the magnet and ball at different distances we are also enabled to decide whether the error is absolute or relative. It is here necessary to break the current by which the ball falls, and to make the current by which the chronoscope starts at the same moment; this is effected by a key specially devised for the purpose. The chronoscope possesses a regulation for alternating its rate when too slow or too fast, but I find it most convenient to make sparing use of this, and apply a correction for each day's determinations as found with the "fall apparatus." Another form of control makes use of a falling hammer, the record being also made with a tuning-fork. A recent device of Ewald combines the two methods by mechanically counting the vibrations of a tuning-fork: a delicate armature is drawn to and released by a magnet with each vibration of the fork, moving the hand of a dial over one of its divisions as it does so. The fork is vibrating constantly, but the making of the signal sends the current into the "interruption-counter," while the re-acting movement again diverts the current away from it. It will record at the rate of one hundred per second. Galton has constructed for ordinary uses a machine in which the signal is given by the release of a rod or pendulum, and the re-acting movement mechanically arrests the fall or swing, a scale of interval being determined for the apparatus empirically. Sanford has devised a simple but not expeditious chronoscope, in which the signal and the response separately set in motion two pendulums of slightly different periods, the re-acting interval being calculated from the number of oscillations occurring before the two are again in unison.

The methods of indicating the moment at which the signal appeared and the moment at which the re-acting movement was made are simple. When the record is written on a rotating surface, a point connected with a magnet, and writing a straight line beneath the vibrations of the fork, writes that line at a different level when the signal is given, and returns to the same level when the re-acting movement is made; or the tuning-fork itself may be made to write at a different level during the interval measured. The arrangement by which the level is changed on the record, or the hands are set in motion in the chronoscope at the same instant that the stimulus appears, is equally simple. For sound, the noise of the key by which the circuit is made is generally sufficient, or other sound may be produced by bodies falling upon various surfaces and thereby opening or closing a key. For sight, the impression to which a re-action is to be made may be concealed behind a screen, and the drawing away of this screen at the same time makes or breaks an electric circuit. Frequently the re-actor sits in the dark, and the impression becomes visible only when an electric spark appears, or the spark itself may be the stimulus. For touch, temperature, and taste, a typical device is that of Vintschgau, in which the end of a rod touches the sensitive surface, and the pressure so exerted makes a contact with a delicate metallic blade inserted in the same apparatus. For smell, the movement by which the odor is set free is similarly utilized. The re-acting movement is usually that of pressing an ordinary telegraphic key. Devices have been constructed by which movements of the foot, of the jaw, of the voice and lip, may be similarly noted. For more detailed descriptions consult the references under this head at the end.

JOSEPH JASTROW.

[To be continued.]

IN the *Atlantic* for September Mr. Justin Winsor considers the "Perils of Historical Narrative," Mr. J. Franklin Jameson contributes a paper on "Modern European Historiography," and Mr. Fiske adds an article on the "Disasters of 1780." These three papers furnish the solid reading of the number.

PROFESSOR A. GRAHAM BELL'S STUDIES ON THE DEAF.

IN the year 1888 the Royal Commission appointed by the British Government to inquire into the question of the care and education of the deaf called to their aid Dr. E. M. Gallaudet, the distinguished president of the National College at Washington, and later Professor A. Graham Bell, whose long interest in the deaf qualified him more than any other public man in America, outside those directly engaged in the work of instruction, to speak with some degree of authority on the questions presented to him. The information presented by Professor Bell has been published in pamphlet form, entitled "Facts and Opinions," and contains a great variety of facts concerning visible speech, heredity, day schools, articulation, and kindred subjects. The Royal Commission has recently completed its investigations, and reported to Parliament the results of its work. I mention the report right here, to draw attention to another of those singular conclusions which have characterized the opinions of men of unquestioned learning and intelligence, when undertaking to speak officially concerning the deaf. In paragraph 398 of this report we find this extraordinary statement, "The want of exercise of the lungs and throat on the part of pupils taught by the manual method is apt to produce chilblains." Two members of the Commission had the good sense to dissent from this paragraph, and officially to pronounce it "quite absurd."

It is impossible within the limits of this article to discuss *seriatim* the several subjects upon which Professor Bell has addressed the public, and I am therefore compelled to make a selection from those studies with which his name has become most closely associated, and from these it will be easily possible to infer the value of what he has done for the deaf. It is also necessary to add, that, in the friendly contention for methods aroused by Professor Bell's long indictment of our American schools, there is on our part a ready recognition of the honesty and zeal which has inspired him; and if we speak plainly on the studies which he has given to the public, we ask for ourselves a recognition of the same sincerity, something of that same chevalier spirit with which he has carried his lance against us.

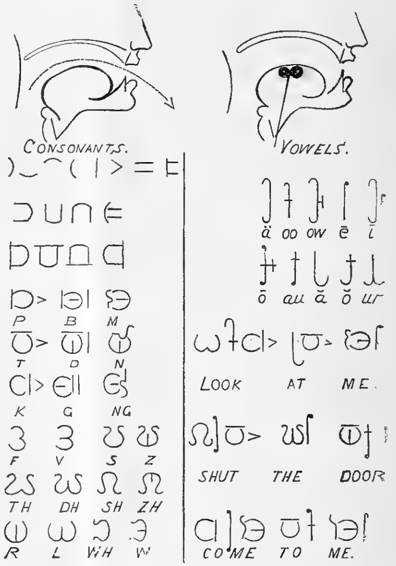
The first measure for the education of the deaf with which Professor Bell became identified was "visible speech." This is a system of universal alphabetics, originated by A. Melville Bell, and was introduced into the United States nearly twenty years ago. The first exposition of this system of vocal physiology in the city of Boston created quite a sensation in literary circles. The extraordinary statement, during the first few months of trial, that "adult deaf-mutes had acquired all the sounds of the English language in ten lessons" (Report Massachusetts Board of Education, 1871–1872), drew, at once, the attention of all those interested in the deaf to this new device. From the report already referred to, and from that of the succeeding year, we find that "the effects produced by this new system are in the highest degree remarkable—even miraculous;" and again, "Perfect and pleasing articulation is certain." To this last claim, it is enough to say that to day there is not a reputable teacher in the United States who makes any approximation to so rash a claim. In view of all that was claimed for visible speech, it is not surprising that it soon became among us a

sort of craze, and that teachers in the art were everywhere in demand. The Clarke Institution at Northampton and the American Asylum at Hartford were fortunate in securing the personal services of Professor Bell, to give special instruction in introducing the Bell method. The number of adherents increased rapidly, and at Worcester, Northampton, and Boston enthusiasts in the cause held conventions to promote the new evangel to the deaf. The sweet optimism of the first disciples was delightful. But this system, from which so much was expected, of which we believed so much and knew so little, has, after nearly twenty years, ended with the quantities inverted. For all purposes of articulation, if not already dead, it is certainly moribund. It has been tried and dropped in the following schools: the American Asylum at Hartford, the Clarke Institution at Northampton, Pennsylvania State Institution at Philadelphia, Western Pennsylvania Institution, Wisconsin Institution, Minnesota, Missouri, Ohio, Kansas, and Tennessee State schools, and at Belleville, Ontario. It is true that in the statistics presented to the Royal Commission, visible speech is still made to hold a place in our American schools, but a glance at some of the remarks accompanying the affirmative answers found in the table on page 2 of "Facts and Opinions" reveals the fact that some of the questions concerning visible speech would have been more correctly answered in the negative. "It is used," says Dr. Gillette of Illinois, "to a very limited extent. It is of advantage to teachers, as it enables them to comprehend physiological facts involved in speech; but for pupils, while it is thus helpful, it requires an amount of time and labor to acquire that can be better improved by the use of diacritical marks." The principal of the school in Florida answers "No" to the question concerning visible speech, but because he uses a method of line-writing adopted by Professor Bell, he is classed among those endorsing the Bell system. Even among those schools where the symbols are still used there is a wide difference of opinion as to its utility. The principal of the Kendall School, Washington, reports that it is used only in the initiatory steps, while in the Horace Mann School, Boston, it is used only with the older pupils. It is impossible to understand the difficulties involved in this system of "visible speech" without some examination of the characters to be studied, and they are here submitted.

These characters, deaf children of eight and nine years of age, coming to school for the first time, never having heard a word of sound in their lives, with minds a complete blank to all the world of sonal thought, were obliged to master and at the same time begin the work of reading and writing English. The wonder is not that the best schools have given it up, but that it was permitted to hold its place among us so long.

The former advocates of visible speech now fall back upon the consolatory reflection, that, although impracticable for children, yet every teacher ought to have a knowledge of it; but unfortunately our best authorities on vocal physiology are not agreed even on that point. There is no one better qualified to speak on questions of this character than Mr. David Greenberger, principal of the New York City School for Improved Instruction, and this is what he says of the Bell symbols: "These hieroglyphs could no more assist a mute in his attempts at vocal utterance, than the signs of the Zodiac." The directive power of the symbols, upon which so much stress was laid, Principal Greenberger declares to be a myth. Every one is willing to admit that a knowledge of vocal physiology is an absolute pre-requisite to all successful teaching of articulation, but this attainment is in no way contingent upon the study of visible speech. If there are those who care to study phonetics, freighted with an alphabet of visual mnemonics, they cannot do better than take up the system propounded by Professor Bell, but that there is any logical connection between the two things, is a contention that has not a foot of ground to stand upon.

The second distinctive educational device which Professor Bell advocated for the deaf was a system of line-writing, a form of visible speech put into short-hand. An experimental school was formed at Washington by the Professor, and at the Convention held in New York City in 1884 line-writing was



explained by one of his teachers, and great things claimed for it. Line-writing was, in fact, a system of short-hand. It is possible that those versed in visible speech may find some connection between the uncials of that system and the strokes used in line-writing. It must be set down to the credit of the six hundred teachers of the deaf in the United States, that, with the exception of one case already noted, all have united in rejecting the use of stenography for young deaf-mutes. The experimental school lived a very transitory life; and in the literature of teaching, only one writer has ventured to utter a word on this last expedient advocated, but not originated, by our enthusiastic friend.

On the question of heredity, Professor Bell has collected a large number of interesting facts. Men may differ as to some of the conclusions drawn from the statistics he has gathered, but there can be no question in regard to the industry and care with which he has devoted himself to this particular line of inquiry. So thoroughly has the danger of deaf-mute offspring from deaf-mute marriages been preached, that

wherever I have heard the question discussed among the general public, there is the greatest surprise expressed that the deaf should have hearing children. The discussions of the past few years have left upon the minds of many intelligent people the impression that the marriages of deaf-mutes are the prolific cause of the increasing number of deaf people in the United States. In considering the sociology of the deaf, it is necessary to bear in mind the following facts:—

The Clarke Institution at Northampton, Mass., opened in 1867. There have been several marriages among the pupils of the school, but none of them have had deaf-mute offspring.

There have been seventeen marriages of the pupils of the Horace Mann School, Boston, but none of the children of these marriages are deaf.

Principal Hutton of Halifax reports thirty marriages of pupils from his school, but only in one case do the children share the infirmity of the parents.

Mr. Mathison, Superintendent of the Bellville Institution, Ontario, says: "Six hundred and sixty-one children have attended, or are in attendance, at this school, and from the records I find that not a single parent of these children is deaf." The principal of the Minnesota School, after an experience of twenty years, and those of California, Alabama, and Mississippi, report a similar state of things in their respective states. But perhaps the most satisfactory statistics concerning the deaf are found in the reports of the Irish Commissioners. In 1881 these commissioners report as follows: "An inquiry having been carried out in the censuses of 1851, 1861, and 1871 as to the children of congenital deaf-mutes, and the result being in each case of a negative character, it was not considered necessary to repeat this investigation, as it appears evident that deafness and dumbness in the parents have no influence in propagating the defect."

In the census of 1871, a minute investigation was made respecting the marriage-state of congenital deaf-mutes, and from 115 unions there were found to be 315 children, of which number only three were deaf. Compare now this result with the number of deaf children from consanguineous marriages, and we find 141 cases of congenital deafness from the inter-marriage in 85 instances of first cousins; in 63 instances of the marriage of second cousins there were 100 deaf children; there were in all 324 cases of deafness from 194 intermarriages among relatives. One striking instance will illustrate the fact that consanguinity in the parents is responsible for a large percentage of deafness.

The Irish Commissioners report that No. 6 in their returns consisted of a family of five children whose parents were second cousins, two of the five children were born deaf. The father married a second time, but this wife was not related to him, and the six children resulting from the union were perfectly developed in all their faculties (Annals, Vol. xxx., No. I., p. 51). In the discussion on the papers read by Professor Bell before some of our scientific associations, he expressed the opinion that consanguineous marriages were not so productive of deaf-mute offspring as people generally supposed. How accurate this opinion is, the facts already quoted will show. No one claims that the mere fact of relationship is in itself a cause for deaf-mute offspring. It is quite probable that some lurking disease, some hereditary taint, becomes intensified in the offspring of consanguineous parents, and the children in consequence become deaf, though why it should affect the hearing is a problem no one yet has been able to solve.

Professor Bell's indictment of the sign-language has been completely answered by Dr. Williams, the principal of the American Asylum at Hartford. By thirty-two cases from schools where signs are prohibited, he has shown that the pupils taught there have all the peculiarities which mark the diction of children educated by means of the sign-language.

Permit me, in conclusion, to cite an instance which indicates a tendency to be guarded against on the part of the Professor, a tendency, too, which has marked the literature of our deaf-mute press in their animadversions on the published addresses which he has given to the public, but, wherever found, the practice is indefensible.

In his address at the Gallaudet Centennial in Philadelphia, the sweeping statement was made that there were 15,000 children of school age not receiving any education. This statement was at once challenged, but the Professor quoted in his defence statistics given in advance by F. D. Wines of Illinois. There would be some justification for this error, if Mr. Wines had not publicly stated, before Professor Bell at the convention in New York in 1884, that the number of children of school age not under instruction was 5,000. The number of deaf-mutes in the United States at the time of this charge was 33,000. Of these, 15,000 were under twenty years of age. The number of children between ten and twenty years of age was 10,000, and of these 6,900 had been under instruction during the period here considered, so that the claim of 15,000 children not receiving any instruction was very wide of the mark. (See Report to British Government, p. 51.)

W. G. JENKINS.

NOTES AND NEWS.

THE railway tunnel under the St. Clair River, between Port Huron, Mich., and Sarnia, Ont., is rapidly approaching completion. Communication between the headings from the opposite sides of the river was effected on Aug. 25. This tunnel is considered the greatest engineering work of the kind in this country.

—On Saturday, Aug. 23, the remains of John Ericsson, the eminent engineer and inventor, were removed from the vault where they were deposited at the time of his death, in March, 1889, taken aboard the United States man-of-war Baltimore, amid imposing ceremonies, and are now on the way to Sweden, the place of his nativity.

—Some habits of crocodiles have been lately described by M. Voeltzkow. Travelling in Wituland, says *Nature*, he obtained in January last seventy-nine new-laid eggs of the animal, from a nest which was five or six paces from the bank of the Wagogona, a tributary of the Ooi. The spot had been cleared of plants in a circle of about six paces diameter, apparently by the crocodile having wheeled round several times. Here and there a few branches had been laid, but there was no nest-building proper. The so-called nest lay almost quite open to the sun (only a couple of poor bushes at one part). The eggs lay in four pits, dug in the hard, dry ground, about two feet obliquely down. Including eggs broken in digging out, the total seems to have been eighty-five to ninety. According to the natives, the crocodile, having selected and prepared a spot, makes a pit in it that day, and lays about twenty to twenty-five eggs in it, which it covers with earth. Next day it makes a second pit, and so on. From the commencement it remains in the nest, and it sleeps there till the hatching of the young, which appear in about two months, when the heavy rain period sets in. The egg-laying occurs only once in the year, about the end of January or beginning of February. The animal, which M. Voeltzknow disturbed, and saw drop into the water, seemed to be the *Crocodilus vulgaris* so common in East Africa.

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CONTENTS:

THE RELATIONS OF THE STATE AND NATIONAL GEOLOGICAL SURVEYS TO EACH OTHER AND TO THE GEOLOGISTS OF THE COUNTRY.[1]

Investigations undertaken in the course of instruction are often carried on in college laboratories, but it is rarely that individuals or institutions, other than the State and National surveys, have undertaken extensive and expensive geological operations. We must except, of course, in this statement those of an economic nature.

The reason of this is that individuals seldom, and commercial organizations never, devote their means to purely scientific investigations; and inasmuch as these investigations require large sums of money, and as they are conducted largely with a view to increasing human knowledge, the expense of them must be borne by the public treasury.

With our official organizations, most of the working geologists of the country, excepting those called consulting geologists, are connected either as salaried assistants, permanent or temporary, or as volunteers. But these organizations carry on their work independent of each other, indeed, without any regard to one another's existence, while individual investigators go each his own way, pretty much as if he had the whole world of geology to himself.

[1] Abstract of an address before the Section of Geology and Geography of the American Association for the Advancement of Science, at Indianapolis, Ind., on Aug. 20, 1890, by John C. Branner, vice-president of the section.

Practically the United States Geological Survey has *carte blanche* to carry on geologic investigations over the whole territory of the United States, and in every branch of scientific work directly related to geology, such as geography, topography, paleontology, physics, chemistry, and statistics.

Now, over this same area, though limited to the States carrying them on, we have our several State geological surveys; while private individuals, educational institutions, scientific societies, and commercial corporations are at liberty to carry on such investigations as they see fit, and all regardless of each other.

In the earlier work carried on by the Federal Government, however, the various Territories were the specified areas to which the National surveys were confined, and now that the whole area of the United States is open to this work a broad-minded and co-operative direction seeks to aid and strengthen the State organizations instead of antagonizing or annihilating them.

But I wish to emphasize the fact that the classification of the geologists of the country, the work within the domain of the National survey, the work within the domain of the State surveys, and that which can be or will be accomplished by private institutions, corporations, or individuals, demand that there should be some definite and better organized co-operation or co-ordination in all this work and among all these men.

The statement has been made that the United States Survey does co-operate with nearly every State survey in the country, but the fact is that the National survey does not know what the State surveys are doing except in a very general way, and that the State surveys know but little or nothing of what the National survey is doing, except, perhaps, as it may happen to be picked up in private conversations and in private correspondence between personal friends.

Please bear in mind that this is not intended as reflecting upon the Director of the United States Survey; co-operation can only exist by the common consent of all the parties concerned, and it is quite as much the fault of the State surveys that there is no such co-operation as it is that of the United States Survey.

What I have to say, however, refers to the internal arrangements and the working of geologists as affected by our own bearing toward the official surveys, toward each other, and toward the science, rather than toward official relations and toward legislation. For these are not matters to be fixed by laws: laws would interfere with that freedom of movement that gives health, vigor, and activity to our scientific bodies and to our scientific men; they can only be determined by common consent and by usage.

The United States Geological Survey stands at the official head of all our surveys and of all our geological work. National work encourages and stimulates State work, and State work re-acts in favor of national work, and both stimulate private enterprise and investigation. The return from all this no man can measure, for it is both material and intellectual, and in both these senses it is felt in every nook and corner of the land.

The National survey is thus doing a work that no other institution can do, and it is able to maintain an organization of geologists that no other institution could maintain. For nowhere, in no country, is there, and at no time has there been, a corps of working geologists superior to that of our present National survey—a body of geologists of which every scientific man, and, indeed, every citizen of this country, may well be proud.

Having no connection with that organization, either present or prospective, I feel at liberty to express this a frank, disinterested and independent judgment.

With its splendid equipment of men and means, what can the National survey best do, and best leave to State surveys and to private enterprise? The question is not asked as implying that the officers of that body are not perfectly competent to decide these matters, but because we feel that a more effectual co-operation can be brought about to the great advantage of every one concerned. So long as more than one organization must occupy the same field, some understanding can certainly be arrived at that will prevent the duplication of work and the waste of energy and of funds. The appliances, libraries, laboratories, equipments, and the large number of special assistants required by a National survey, are quite beyond the means of our modest State surveys.

The great size of our country, the wide sweeping character of its general geologic structure, and the limits placed by civil boundaries on State work, must throw most of the important general questions into the hands of the National survey. Local details can and should be worked out by the State surveys, and these results should be placed as soon as possible at the disposal of the specialists of the National survey. It is self-evident that problems that can be solved only after a wide experience and acquaintance with the whole country can not be satisfactorily undertaken by the State surveys, but that they must be solved by the larger and stronger organization.

There are certain classes of work that, of necessity, fall upon a National rather than upon the State surveys; such are triangulation, precise levels, topography, paleontologic work, almost all investigations falling under the head of what is usually known as pure science, and all those investigations requiring much time and labor and money and many specialists. The reasons why State surveys can not do work of this class are not far to seek. The men with whom the National survey has to deal are our broadest minded statesmen,—men who comprehend the scope and importance of purely scientific work, while, as a rule, State legislators look to immediate and what they call practical results. Such men can not be convinced of the importance of any work that looks not to the immediate material prosperity of the State, while they are but little concerned, as a rule, with the intellectual income from it.

It is entirely beyond the means of any State survey to make a topographic map of the entire area of the State: the best it can do is to select a few typical areas and map those. But maps are absolutely essential to satisfactory geological work, and map making has come to consume a constantly increasing share of the money appropriated for geological surveys, both State and National. The National survey, however, having large appropriations for topographic work, and contemplating as it does the mapping of the entire area of the United States, ought to do this work.

That these maps must meet various demands, and must therefore be constructed with varying degrees of accuracy and detail, every one will admit. As a matter of fact, however, the maps made are usually, as they should be, parts of a plan, and upon a scale for mapping the whole of the United States. This plan and scale may be perfect for that particular purpose, but it often happens that neither the plan nor the map is adapted to the purposes of the State surveys. And certainly nothing can be plainer than that the maps made by a geological survey ought to be available for geological work, or that, failing to meet the demands of geology, there is no geological excuse or reason for their existence.

Geodetic work can not be carried on by the States, because States are but small parts of and furnish but few points in geodetic questions. European countries have even been obliged to unify their work. In the United States work of this character must be left to some institution of the general government. That paleontologic work should be relegated to the National survey seems to me scarcely to admit of question.

It might be urged against these reasons that the States of Illinois and New York afford striking examples of the fact that States may and can and do carry on a high grade of paleontologic work. But it should be remembered that the conditions under which these excellent results have been obtained have passed or are about to pass away. For, while the States of Illinois and New York have grown in wealth and intelligence since their surveys were begun, the Legislatures of those States could not to-day be induced to take up and carry forward works of so purely a scientific nature; and if those States could have seen the end from the beginning it may well be doubted whether they would have undertaken the great paleontologic investigations carried on so long and so successfully by Hall and by Worthen.

Another point which I must insist upon is that it is the place of a State geological survey to do what is wanted in the State, and as a rule economic results are wanted. The people are entitled to what they pay for. Not that the survey must go on every wild-goose chase suggested and examine every prospect and claim in the country, but the problems which the people wish to have solved should be solved if they can be solved.

These very demands define the work of the State surveys, and separate it pretty sharply from that of the Government survey. If we are to be perfectly honest with ourselves, we must confess that State surveys have, as a rule, failed to do what the people have expected of them, and one of the principal reasons for these failures is that the geologists have not had the counsel and the co-operation of a National survey. The geologists who have encouraged the making of appropriations for the work have invariably held out the hope that these surveys would be devoted to economic geology, while members of Legislatures who have supported such bills have invariably done so in the expectation that they would do something of direct economic importance. But there are but few exceptions to the rule that these State appropriations have been devoted to paleontologic problems and to pure science, while economic problems have been entirely lost sight of.

These economic problems, or such of them, or rather, perhaps, such phases of them as can safely be dealt with by a State, should be the special province of the State surveys, while the broader questions which can be satisfactorily studied and safely discussed only over wide areas should be left to the National survey.

It is true that economic and purely scientific problems cannot be entirely separated, and there is no necessity that they should be, but geologic work may give preference or prominence to one or the other phase of the question as the case may demand. I have said that economic problems should, in so far as possible, be left to the States. There are cases, however, in which this cannot be done, for there are often those which, requiring study over a wider area, cannot be solved in a single State. These should be studied in part or entirely, as the case may demand, by the National survey.

It seems plain, in so far as the relations between the National and the State surveys are concerned, that the National survey should leave all that it can safely leave to private enterprise and to State surveys, and it should deal with those problems which State surveys and individuals will not or can not satisfactorily deal with.

It is my opinion, also, that the National survey, being better informed of what is going on in the way of geologic work than the State geologists, and being in every respect the strongest of our organizations, should hold out a helping hand to the State surveys, and from their wider and more valuable experience, give advice and encouragement to State work. In this way State aid to scientific work would be encouraged and the National survey would widen its helpful influence.

It goes without saying that State and National surveys should not ride rough shod over each other just because there is no law to prevent their duplicating each other's work or their doing work that will interfere with each other's plans or efficiency. It would be easy for a Government survey to discredit and embarrass a State survey to such a point that the State would put a stop to its own work. Fortunately, our National survey has been conducted rather with a view to aiding the State surveys. But this aid can be made much more effectual than it ever has been, and I have no doubt it will be made so whenever we are all ready for such co-operation.

What must a man's feelings be when he brings his contribution, to find that it is in the wrong place, or that it is not wanted. Mistakes of this sort are constantly being committed in geologic work, and in abundance too, all because we have no recognized directing head for the work done outside of the United States Geological Survey.

The bulk of geologic literature must yearly become greater, and unless it becomes at the same time better, we must expect a day to arrive when geologists may well stand appalled before it. Much of the literature is practically worthless; it is an encumbrance rather than a help to the progress of science, and we should feel grateful to any method that would deliver us and geology from an evil which is coming to be a more and more serious one.

In one of the States in which the United States Survey has been doing topographic work, an area of 3,000 square miles that had already been surveyed had to be remapped by the State survey to meet its own demands. Here, I think, no one will have any diffi-

culty in understanding the necessity of co-operation between the State and the National surveys.

Take as another example the chemical analyses made for geological purposes. The chemists of State and National surveys have thrown upon them a vast amount of heterogeneous work, while but little or no time is left them for original investigations. A great many of their analyses are duplicated elsewhere, or may be duplicated in any number of laboratories, so that investigations that might otherwise have been possible are prevented, and both chemistry and geology are hindered.

The errors made by geologists not connected with the surveys are mainly due to haste, or, in other words, to expression of opinion based upon too limited observations. But only limited observations are possible to men of limited time for the work, and limited means to work with, a limited area to work in, limited acquaintance with field geologists, and limited opportunities for publication. There are many young geologists and men of but little experience—amateurs—whose efforts are not so directed as to be of as much service as they might be. They lack neither zeal nor means in many cases, but they do lack some one to guide their tottering footsteps. Their want of experience gives them but a restricted view of the field in which they are laboring. Their labors can not, therefore, unless directed by some one who has a sufficiently broad view of the whole field, be of any value to geology. Who will direct them? Or shall they go on piling higher their wasted energies, and find themselves when they have come to the end with the mortification of knowing that, though they have worked hard and faithfully, they have, in reality, contributed nothing to the sum of human knowledge?

If we could have some sort of co-operation, a man at work upon a particular subject would have some assurance that his field of operations would be, within all reasonable limits, left to him. As matters now stand a geologist is often obliged to mount guard over his own grounds and his own work to keep the unscrupulous and unbridled camp-followers of science from walking off with and getting the credit for the results of his labors.

Co-operation would enable each one to concentrate his efforts upon that line of work or that investigation in which he is especially interested. As matters have gone heretofore, no State survey and no man on a State survey has been able to take up any one subject in a systematic and thorough manner unless it has happened that some one group of facts has been available in his own State alone. Take any topic you may choose for a test, and you will find this to be an invariable rule.

Do the best we may, there is not one of us who may not be benefited more or less by a friendly criticism. And it is of great importance to the science that these criticisms be made before our results or observations are published. In this way we may avoid adding to that vast talus of geologic trash beneath which the science of geology is buried more and more each year. Such criticism is not possible except under conditions that enable us to know the lay of the land with reference to other geologists and to what they have done and are doing.

It should be distinctly understood from the outset that such work is to be, not subordination, but co-ordination, and above all, co-operation. The demands of scientific work do not require, and the conditions and peculiarities surrounding scientific ambition and devotion do not admit of the most successful and satisfactory work being done by machinery.

I would not by any means destroy the autonomy of local societies or of independent workers not formally connected with the public surveys. Certain independence of thought and action is essential to scientific advancement, and friendly rivalry is not only not injurious, but it is extremely helpful, and in many cases absolutely essential. I have no idea that a "perpetual motion" sort of a geological machine can be devised, or that any arrangement or adjustment of parts is possible which will entirely do away with friction.

It is scarcely possible that any device that can be made or suggested would be perfectly satisfactory, but it certainly is reasonable to expect that some system of co-operation can be devised and put into practical operation. If ever such co-operation should be brought about, several points must be kept in mind by us all. As much latitude as possible would have to be allowed individuality. Men are not like pieces of coal to be separated and classified by sizes or by specific gravity.

Administrative methods devised for scientific work, like those of diplomacy, are often a series of compromises, and good sense must make up for the defects of any system.

No plan of co-operation can succeed if we do not all take a broad and unselfish view of science and its functions. Local talent should be utilized. It would in many cases save a good deal that now goes to pay travelling expenses, to say nothing of the importance of keeping all the geologists of the country actively interested in geological work.

Now, if geologic work can be improved by being under the nominal direction of those best fitted to direct, where are we to find our directors? The men who have done most to popularize the science of geology in this country are our professional geologists, and it is not unnatural that we should turn to them. But the teachers of a science are not necessarily the best directors of research, while they are probably in no case thoroughly conversant with the work being done by the various State surveys and by the National survey.

The direction of work over the whole country would be quite as impossible, or even more so, from the States.

The National survey, standing as it does at the head of all the geologic work done in the country, having the whole national domain as its field, and composed, as it is, of our best geologists, and having the most thorough organization, is, or should be, the natural head and director of all geological work in this country. I have no doubt that the National survey would be glad to help, in so far as it can, to unify and give useful direction to this work.

I take this ground in the face of the statement of the distinguished Director of the United States Geological Survey, who has said that "all of this scientific research under National, State, or local patronage cannot be controlled by some central authority as an army by its general, from the fact that scientific men, competent to pursue original research, are peculiarly averse to dictation and official management. Scientific men spurn authority, but seek for co-ordination."

Such a statement as this must necessarily be taken with some allowance. The function of a director or of a superior, in science at least, is not, to be sure, that of a commander ordering here and there men who must act like machines, who must have no independent opinions or plans of their own; he must rather be a helper, a man to encourage, to suggest, to fire with enthusiasm those under him, and to unify the work of the organization of which he is the head. Scientific men do not spurn authority if there is any reason for it, and as a proof of it we may cite the United States Geological Survey itself, as well as all the State Geological Surveys in this country, or, for the matter of that, in the world. The members of these surveys submit to all reasonable authority, but they are also put upon congenial work, and they are permitted to do that work pretty much in their own way. Now, why can there not be an organization of all geologists, more or less similar to this?

We may disabuse our minds of the thought that there is a probability or even a possibility of the Government monopolizing geology. It can't do it; geology belongs to the geologists, whether the Government helps carry on geologic investigations or not.

My conclusions are:—

1. That the great and valuable contributions to geologic knowledge must be made by our official surveys, for they alone have the means for producing them—for gathering the facts, giving the necessary time to philosophical thought and discussion, and for furnishing the necessary illustrations and distributing the publications.

2. That economic problems should be left, in so far as it is possible, to the State surveys, while the National survey should deal with those requiring larger means and a wider range of observations.

3. That all the working geologists of the country should be brought into official or quasi-official relations with the State and National surveys, and their efforts and skill thus utilized.

I am free to admit, however, that no plan of operation or co-operation can be devised that will work to the complete satisfaction of everybody. We sometimes have men to deal with who are not amenable to either law or reason.

In his presidential address before the American Association at Cleveland, Professor Langley compared the advance made by scientific men in their search after truth to that of a pack of hounds following a trail. Permit me to carry this simile still further. Hounds understand that it is their business to follow the game, and, when left to their own instincts and wishes, they will follow it. Now imagine a bull dog seized with the ambition to become a hunter and joining the pack of hounds. Every one knows that the bull dog will, in spite of any thing that can be done, have a fight with half a dozen, or, more likely, with the whole pack of hounds, by the time the chase is well under way.

It is not a pleasing reflection to remember that the great search after truth, in which every genuine man of science is engaged, heart and soul, is often interrupted in this same fashion by the pugnacious disposition of some companion.

Let me recapitulate some of the benefits to be derived from voluntary and cordial co-operation between all geologists and all geologic organizations in this country:

1. Geologic research being under the nominal direction of the leading investigators, would be so conducted as to be of the greatest utility to the largest number.

2. When a piece of work was done by one it would be done for all, and duplication by State surveys and by individuals and the consequent waste of energy, time, and money would cease.

3. The functions and fields of official organizations being better defined, State and National surveys and individuals could so direct their efforts as to serve the purposes of others without neglecting their own immediate aims and without infringing upon each others' grounds.

4. National and State surveys would be strengthened, and local organizations and individual effort encouraged.

5. It would give us a better geologic literature, better instruction, better geologists, and more thorough specialists.

6. And finally, we trust, it would put a stop to those oracles of science who are so ready to prophesy in its name. This ideal state of affairs may never be brought about, but it is none the less desirable that we should aim at it. For the more nearly we approximate to it the more rapid will be the progress of science, and the progress of science is the progress of civilization.

To paraphrase a recent utterance of Bishop Potter, "It would be a monstrous conception of science if any one of us were to esteem it only as a selfish weapon with which he was to carve his way to personal fame and fortune." It has often been used for just that purpose. Higher ideals will give us nobler motives.

ON CERTAIN PHENOMENA OF GROWING OLD.[1]

AFTER a few introductory remarks on the choice of a subject, Dr. Minot said that he had been guided in his selection by the idea of taking a subject which would be of general interest and indicate, if possible, the new directions in which biology is developing. For this reason he had chosen the subject as announced in the title of the address. He spoke first of the law of variations as connected with the age of the living organism. When variations occur which are due simply to chance, it is found that they are distributed according to a regular curve on either side of a maximum; but when we study the variations which occur in the living organism we find that there the curve is irregular, and that there is a certain point of maximum which occurs at a definite age, and that the ascent of that curve toward the maximum is steeper upon the young side than upon the older. The speaker presented a number of examples of this taken from the age at which Harvard students enter college, from the growth of children, from the age at which maturity is attained in the female sex, from the age of mothers and the number of children which they have had at each age, and giving other examples, without, however, presenting them in statistical form. In all of these cases the same peculiarity of the curve being steep on the young side, and less steep upon the old side, recurs. But in all these cases the maximum occurs at a comparatively early period of life. In other cases, as, for instance, when we discuss the relation of suicide to age, we find that the maximum frequency occurs at a much more advanced period, and in this case the curve becomes steep upon the old side, so that there is here a large field of statistical inquiry which is to be worked out, and there is a large amount of material which might, if properly put into shape, yield valuable results. We might study from this point of view the relation of various diseases to age, the relation of the birth of the first child to the age of the parent, of the acquisition of fame, the age of second marriage, the age at which distinguished authors have published their first book, the age of entering the United States Senate, etc. All these and other similar data might be utilized for the purpose of the biologist to study the law of variation in connection with age. At the present time there is not sufficient work done in this direction to enable us to draw any more general conclusion than that which has been presented above.

The peculiarity of the curve of variation is unquestionably due to what may be called senescence, or growing old. This senescence shows itself in the fact that toward the younger period the same range of alteration takes place as toward the older period in more advanced age. This is particularly well illustrated by a series of elaborate experiments upon guinea pigs and their growth made by the speaker. These experiments, which were interrupted by an accident which destroyed the whole stock of animals, show that the loss of vital power commences with birth, and that in order to add a given percentage to the weight of an animal a much longer period is required when it is old than when it is young. This was illustrated by statistics and diagrams. The general result may best be expressed by saying that the older an organism is, the more time it requires to produce a given change, and this indicates that there is a progressive loss of vitality. The difference between this view and the current one is that, in the speaker's opinion, there is, scientifically speaking, no period of development, but only a steady decline from birth onwards.

The speaker then turned to the second part of his subject, and discussed how far anatomical peculiarities can be found to be correlated with this progressive line of vitality. He took up the various tissues of the body, considering them one after another in their order of development, and showed that in each one of the principal tissues and organs the cells composing them exhibit the same peculiarity; namely, that in their young condition they contain only a small amount of protoplasm, and in their adult condition a very much larger amount, so that the proportion of protoplasm to the nucleus increases with the age of the organism. This fact, which can be readily verified in the case of the higher animals, finds also certain support in the development of many of the lower forms, which were also briefly discussed. Hence the conclusion that the development of protoplasm is associated with the loss of vitality, and that instead of speaking of protoplasm as the physical basis of life, we might speak of it as the physical basis of advancing decrepitude; or, since the changes involved in growing old lead to death, we might designate it as the physical cause of death. These definitions of protoplasm are too dictionary-like, and might be misleading if taken strictly, but they can at least teach us that protoplasm is by no means a simple jelly which explains in a simple manner all the phenomena of life, but it is in reality an extremely complex substance, as complex as life itself. We see in this problem of age a series of phenomena which are not especially associated with any organ or any system of organs of the body, but something which involves all parts alike. Such a study as this goes, strictly speaking, in the direction of general biology. Hitherto we have had comparative anatomy and physiology, but of general biology extremely little. The speaker expressed his belief that the future of biology would lead in this direction, and that the study of the organism as a whole would supercede in the near future to a large extent the present study of the separate organs, both in their physiological and morphological aspects.

There is a great deal to be done, for it is only in the domain of

[1] Abstract of an address before the Section of Biology of the American Association for the Advancement of Science, at Indianapolis, Ind., Aug. 20, 1890, by Charles S Minot, vice-president of the section.

general biology that we can seek the solution of the problems of reproduction, heredity, sex, growth, variation, death, the evolution of species, and the general economy of nature. All of this phenomena are common alike to the vegetable and the animal world, and for their thorough study it is necessary that the investigator should be strictly a general biologist and not merely a botanist or zoölogist. These investigations are necessarily expensive in character, since they require that the animals and plants experimented upon be kept under specific conditions for long periods of time; but, it is to be believed that the results which may be obtained will amply justify both the labor and the expense. The speaker expressed the hope that some persons who felt generously inclined to aid in scientific work might give support for this line of work, and in concluding expressed the more general hope that those persons of wealth who wish to contribute to science may feel more and more inclined to endow research, for much can be accomplished in this way than in any other for the advancement of science.

Wherever we turn we see scientific work of the highest quality delayed and even stopped for the lack of means. Every one who can rescue these opportunities from being lost, even in part, will deserve well of mankind and the acknowledgments of the association.

AMONG THE PUBLISHERS.

—California topics occupy considerable space in the September *Century*. A paper of interest, practically illustrated, is Commander C. F. Goodrich's description of "Our New Naval Guns," detailing the process of manufacture and recounting their remarkable efficiency.

—Thomas Stevens (who went to meet Stanley when the latter was coming from the interior of Africa) speaks of his article on "African River and Lake Systems" in the September *Scribner's*, as suggested by several interesting discussions of the subject while he was in Zanzibar and Cairo—notably one with Mason Bey, one of the best authorities on African affairs, who with Prout (a name familiar to readers of the magazine) explored the White Nile in 1877. Much of the information which he gained from Mason Bey appears in Mr. Stevens's article. Professor Shaler of Harvard, in his article on "Nature and Man in America," in the same number says: "It seems to me that it is rather to the physical conditions of North America than to any primal incapacity on the part of its indigenous peoples to take on civilization, that we must attribute the failure of indigenous man within its limits to advance beyond the lowest grades of barbarism. The Indian shows us in many ways that he is an able person. We may judge any folk by their greater men, and there can be no doubt that the ablest of our American savages rank high in the intellectual scale. It is, it seems to me, to the ceaseless disturbances of nascent civilization that we owe the failure of this folk to attain to a higher grade." Apropos of railway strikes, James S. Norton, a prominent Western lawyer, says, in the same issue, "If a corporation is held to strict performance of its duty as a public servant, should not its agents, who live upon its business, be held to some account—at least for combinations made to obstruct a public service as a means to satisfy the personal grudge of a few individuals?"

—The September number of *The Forum* will contain a political essay on "Money Interests in Political Affairs," by E. L. Godkin, editor of the New York *Evening Post*, in which Mr. Godkin traces to the growth of protection the enormous and alarming increase of the influence of money in politics, which he regards as the most important political fact of our time. In the same number Senator John T. Morgan of Alabama replies to Senator Chandler's recent article on "The Federal Control of Elections." Other articles in this number will be "The Training of Teachers," by President G. Stanley Hall of Clark University; "The Christianity of the Future," by Professor John S. Blackie of Edinburgh; "The Latest Astronomical News," by Professor Charles A. Young of Princeton;

Publications received at Editor's Office, Aug. 11—23.

BALLOU, W. R. A Compend of Equine Anatomy and Physiology. Philadelphia, Blakiston. 205 p. 12°. $1.
BREWER, W. H. Warren's New Physical Geography. Philadelphia, Cowperthwait. 144 p. f°.
CHITTENDEN, E. P. The Pleroma. A Poem of the Christ. New York, Putnam. 347 p. 8°. $2.50.
DAY, D. T. Mineral Resources of the United States, 1888. Washington, Government. 652 p. 8°. 50 cents.
DENTAL Mirror. Vol. I. No. I. m. New York, Dental Publ. Co. 16 p. f°. $1.
DRAGON Flies vs. Mosquitoes. Can the Mosquito Pest be Mitigated? (The Lamborn Essays, by Working Entomologists.) New York, Appleton. 202 p. 8°. $1.50.
LITCHFIELD, Mary E. The Nine Worlds: Stories from Norse Mythology. Boston, Ginn. 163 p. 12°.
MARCON, J. B. Bibliography of North American Paleontology in the year 1886. Washington, Smithsonian Institution. 57 p. 8°.
POULTON, E. B. The Colours of Animals, Their Meaning and Use, Especially Considered in the Case of Insects. New York, Appleton. 360 p. 12°. $1.75.
SCHOFIELD, A. Health at Home Tracts, 1-12. London, Rel. Tract Soc.; New York, Revell. 192 p. 12°. 60 cents.
SMITH, E. F. Electro-Chemical Analysis. Philadelphia, Blakiston. 116 p. 12°. $1.
UNIFORMED Rank Argus. (Published in the interests of the Uniformed Rank, Knights of Honor.) Vol. I. No. 1. m. New Orleans, C. H. Ludwig. 4 p. f°. 50 cents.
WALKER, F. Practical Dynamo-Building for Amateurs. (Science Series.) New York, Van Nostrand. 104 p. 16°. 50 cents.

"Protection Against Tornadoes," by Lieut. John P. Finley; as well as articles by Simon Sterne, Edward Everett Hale, James E. Murdock, M. J. Savage, and Alice E. Ives.

—The Religious Tract Society of London, believing that due care of the body is as much a Christian duty as concern for the soul, makes it an important part of its work to diffuse sound information, in a popular and readable form, in such a way as to lead people to use all the means in their power to preserve their own health and the health of those dependent upon them. With this object in view, the society has issued a neat little volume entitled "Health at Home Tracts," written by Alfred Schofield, M.D. The book is made up of a dozen tracts which had previously been issued separately, and which had been so well received by the public that their publication in the present form was determined upon. Fleming H. Revell of New York and Chicago represents the Tract Society in this country.

—It appears from a publication recently issued by the Government Statistician of New South Wales that many descriptions of gems and gem stones have been discovered in various parts of the Australian colonies, but no systematic search has been made for any but the diamond. Diamonds are found in New South Wales, Victoria, and Queensland, but only in the first-named colony have any attempts been made to work the diamond drifts. The principal diamond fields are situated at Bingera, near Inverell, in the New England district The Government of New South Wales has, on various occasions, obtained the services of experts to report upon the fields, as well as the gems which have been from time to time extracted from them, and these reports, it is said, have generally been of an encouraging nature. The number of diamonds found in the colony to the end of 1887 is estimated at 75,000, the largest one being of 5⅝ carats, or 16.2 grains The diamonds occur in old tertiary river drifts, and in the more recent drifts derived from them. The deposits are extensive, and have not yet been thoroughly prospected. The New South Wales diamonds are harder and much whiter than the South African diamonds, and are classified on a par with the best Brazilian gems. During the year 1887 the diamond companies at Cope's Creek, near Bingera, produced about 23,000 diamonds, weighing 5,151 carats; but in 1888, owing to the severe drought which occurred, the search for diamonds had to be temporarily abandoned.

—The September number of the *New England Magazine* will be strong in agricultural articles. James Knapp Reeve tells of the advance of agricultural schools, and traces back the history of agricultural education. Another paper in this series gives an interesting treatment of the present condition of the farmer, while an article with the title "Moses in Massachusetts" cannot fail to stir up interest, especially among the readers of Henry George. The *New England Magazine* is bent upon honoring the South. The University of Georgia comes second in her series of illustrated articles on the colleges of America, and is presented by Charles Morton Strahan in this number with a series of engravings.

—In *Lippincott's Magazine* for September, Rear-Admiral Daniel Ammen, one of the chief promoters of the Nicaragua Canal scheme, contributes an article which gives a history of the inception of the project and the progress made up to date, and indicates the results which will accrue from the construction of the canal. A timely article upon "Current Concentration of Industrial Capital" is contributed by Henry Clews. He inveighs in strong terms against the present "trusts" and "combines," and predicts their speedy downfall. He holds, however, that some form of combination is necessary to all large enterprises, and that existing State laws relating to corporate enterprises need but to be broadened in their scope, and more strictly defined in respect to their safeguards, in order to keep all combinations within proper bounds. Alfred C. Haddon gives some interesting descriptions of various dances he witnessed among the Papuans of Torres Straits, and Charles McIlvaine (Tobe Hoge) has an entertaining article upon "Superstitions about Birds."

ALTHOUGH about 100,000 tons of cheese are made annually in Great Britain and Ireland, nearly an equal quantity is imported from abroad, chiefly from North America and Holland. The foreign imports almost double each ten or fifteen years. In 1850 they received 347,803 hundredweights of foreign cheese; in 1860, 583,283 hundredweights; in 1870, 1,041,281 hundredweights; in 1880, 1,775,997 hundredweights; and last year, 1,908,000 hundredweights.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED—Index to Vol. VIII. and a copy of No. 205 of SCIENCE. Ten cents will be paid for a copy of either of these if in good condition. Publisher of SCIENCE, 47 Lafayette Place, New York.

TO PRINCIPALS OR COMMITTEES.—Professor of Classics and Sciences, experienced in advertising and building up schools, now employed, desires change. WILLIAM, Roslyn, L. I.

WANTED.—A graduate from the Advanced Course of the Framingham State Normal School desires an assistant's position in a high school. An appointment in New England preferred. Address G., Lock Box 4, Framingham, Mass.

HYBRIDS.—A. M. Suchetet, 10 Rue Alain, Rouen, France, desires to correspond with those possessing hybrids, either living specimens or stuffed, of mammals, birds or other animals.

WANTED.—A Mining Engineer of standing and experience. One having had practical experience in Coal Mining and the manufacture of Coke preferred. Address A., care "SCIENCE."

CHEMIST.—A Harvard Graduate and Specialist in Chemistry desires a position with some manufacturing industry, or with a practical chemist. He would make an engagement to take charge of a laboratory and lecture on Chemistry. He has had large experience in the laboratory and school-room, and can give the best of references. Address J., Harvard College, Cambridge, Mass.

WANTED.—A Lady Teacher, at present teaching in England, with 12 years of very successful experience in primary work, desires a similar position in America. An appointment in the State of Ohio, or the City of New York, preferred. Excellent references, etc. Address in July or August, L. DUNCAN, Poste Restante, Stainland, Halifax, England.

A ZOOLOGIST, acquainted with the United States, graduate (Ph.D. Freiburg, B.Sc. of an English university) of many years' standing; late Fellow of an English college; late assistant to a German university, professor of Comp. Anatomy; many years a student at two German universities; pupil of Huxley, Kölliker, Semper, Wiedersheim and Weismann; author of many well-known memoirs on Comp. Anatomy and Embryology; thoroughly conversant with all branches of the subject; fond of teaching, with good testimonials, seeks a Professorship. Address "MORPHOLOGIST," Office of SCIENCE. Other information and a few testimonials can be seen at the Office of SCIENCE.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I wish to exchange Riley's Missouri Reports, either singly or full set, for Proceedings Entomological Society, Philadelphia, vols. 2 to 6 inclusive. Will also exchange Casey's Revision of the *Stenini* of N. A. and Horn's Revision of the *Tenebrionidae*. F. M. Webster, La Fayette, Ind.

I wish to exchange a fresh and complete set of Weiss and Spier's "Necropolis of Ancon" for other books, either new or second-hand, if the latter are in good condition. What have you to offer? Address Warren Watson, Kansas City, Mo.

1,000 botanical specimens representing 250 genera in exchange for those not in my collection. Send list of duplicates, and receive a similar one to choose from. Address E. E. Bogue, Orwell, Ashta Co., Ohio.

For exchange—14 volumes (1883-1889) American Journal of Science, 10 volumes (1880-1889) American Naturalist, 21 volumes (1879-1890) English Mechanic, all in good condition for binding; also, Morris Typewriter. Wants first-class microscope, camera, chemical or physical apparatus. Address, with full particulars, E. R. Chadbourn, Lewiston, Maine.

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted—To furnish roots of *Dodecatheon Meadia*, *Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

SCIENCE

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BEVERAGES.

ALL beverages contain water as their chief constituent, and they may be divided into two classes, alcoholic and non-alcoholic.

Alcoholic Beverages.

Alcohol is the product of the alcoholic fermentation of any saccharine material, and these materials may be arranged in three groups: first, grapes and other sweet fruits which contain fermentable sugar or glucose, the expressed juice of which at once enters into fermentation on exposure to air; second, substances which contain common or cane sugar, the first step in the process of fermentation being the formation of glucose by taking up the elements of water; and, third, the various kinds of grains, potatoes, and other substances containing starch, which by the action of a peculiar ferment, diastase, naturally, or by the action of dilute mineral acids artificially, is converted into glucose.

FERMENTATION.—In the manufacture of both malt and distilled liquors the object is to convert the starch of the grain employed, by suitable fermentation, into alcohol. In the one case a low percentage of alcohol is striven for, and in the other the maximum amount that is capable of being produced.

Chemically speaking, fermentation takes place wherever an organic compound undergoes changes of composition under the influence of a nitrogenous substance called a ferment, which acts in small quantities and yields nothing appreciable to the fermented substance. These ferments are living minute vegetable cells, and different varieties are found in the various fermentations with which we are familiar, viz., alcoholic, acetic, lactic, butyric, etc.

In normal alcoholic or spirituous fermentation we find the minute vegetable cells commonly called "yeast" growing and multiplying, assimilating the sugar or glucose found in the infusion or solution (whether the glucose is derived from the starch of the grain, by the action of another ferment called diastase, or artificially prepared), and excreting a large proportion in the form of carbonic acid and alcohol.

Theoretically 105.3 parts of glucose, corresponding to 100 parts of cane sugar, would produce about 51 parts of alcohol and 49 parts of carbonic acid, but as a matter of fact Pasteur and other investigators have found that there were small quantities of other products present, so that the theoretical yield is not obtained.

Under the general name of ferment or yeast a large number of varieties and species are included, which resemble each other in form, but differ greatly in their properties and characters. The germs of these yeasts are everywhere floating in the air, especially in the hot summer months, and when they encounter a favorable soil for their development they grow and multiply like other plants under similar conditions; for instance, when they attach themselves to the stems and skins of fruit, they give rise to the "spontaneous" fermentation of grapes, apples, pears, etc.

In addition to the yeast germs, the air of any locality contains numerous living organisms, the mould, bacteria, and other micro fungi, for the most part injurious to the making of the wort or wine, and forming the true ferments of disease.

Among all these ferments several species will set up alcoholic fermentation in the wort or grape juice, and transform it into alcohol and carbonic acid, but all of them will not give a good product. On the contrary, the great majority of these spontaneous yeasts would have disastrous effects, for the brewer especially, decomposing the beer to such an extent as to render it unsalable.

The species called *Saccharomyces cerevisiæ* constitutes the large class of beer-yeast proper, and the one the best known and studied. Two varieties of *Saccharomyces cerevisiæ* are extensively cultivated, the high or upper (*obergährung, fermentation haute*), and the inferior or lower (*untergährung, fermentation basse*). The former is used with a high, 15° to 18° C. (59° to 65° Fahr.), temperature, the yeast and impurities rising to the top of the vat, whence they are removed by skimming; and the latter at a low temperature, between 4° and 10° C. (39° to 50° Fahr.), where the fermentation takes place slowly and the yeast settles at the bottom in a compact mass. Each variety will produce its own peculiar and characteristic fermentation. A mixture of either of these varieties with one or several other species of *Saccharomyces*, as *S. ellipsoidens*, *mycoderma*, etc., results in disaster to the wort.

The wort and grape juice naturally present a proper soil for these harmful as well as for the proper or true ferments, and it is not surprising that the germs of the noxious flourish and develop to the detriment of the true yeast plant.

These yeast plants and germs are so minute as to require the use of a microscope with high-power objectives to discern and differentiate them. Like all other fungi, they are capable of distinct cultivation; and with the exercise of some care, and the assistance of a trained observer, a brewer, distiller, or wine manufacturer, after some experiments, could maintain a crop of such particular yeast plant as yields the best results and gives a uniform product.

This method of "pure" cultivation has been extensively

employed in breweries in Denmark, Germany, and elsewhere in Europe, and there is no scientific reason why the same system should not be carried on in this country to the great improvement of our beers and wines.

At the old Carlsberg brewery near Copenhagen, Professor Hansen has cultivated two varieties of bottom *S. cerevisiæ*, which give different results in practice. One gives a beer well adapted for bottling, and is chiefly employed for home use. The other gives a good draught beer, containing more carbonic acid than the former variety; it is not adapted for bottling, but is much preferred by German brewers, and is therefore chiefly cultivated for export.

Experiments upon an industrial scale are being carried on at Burton-on-Trent, in England, with different species of pure yeast. Several varieties of *S. cerevisiæ* have been separated from the yeast generally employed and cultivated, which, when used on a practical scale, give entirely different results, both as to flavor, brightening, attenuation, and mode of separation of the yeast. Experiments have also shown that these characteristics can be maintained unimpaired throughout a very great many successive fermentations in the brewery. Cultivations have been started from a single yeast cell, and with proper care have been maintained for a long time.

On a commercial scale the cultivation should be conducted in sufficiently large vessels to yield the necessary amount of yeast used for fermentation. For this purpose two vessels should be employed, one in which the wort or other sugar solution used for cultivation is sterilized by being boiled, then stirred and aerated, excess of pressure being prevented by means of air filtered through sterilized cotton; into the other (the fermenting vessel, previously sterilized by steam) the sterilized wort or sugar solution is forced, and pure yeast from the laboratory added. When the fermentation is at an end, the liquid is run off, the apparatus filled with wort or sugar solution, stirred, and very nearly emptied. The wort so obtained, and containing yeast, is then transferred to the brewing vessels; the residue in the apparatus, with the addition of sterilized wort, serves for the future production of yeast. Pure yeast can thus be continually obtained without fresh inoculation, as the small amount remaining in the fermenting vessel serves this purpose. These vessels are jacketed and provided with the necessary safety-valves, ventilators for admitting filtered air, exit tubes for the escape of steam and carbonic acid, thermometers and manometers for regulating temperature and pressure, and inlets and outlets for wort, beer, and yeast.

Distillation.—The object of the distiller is to separate the alcohol contained in the fermented wort from the foreign matter with which it is associated. For this purpose he has resort to a still. The alcohol thus produced is not, as has been well known for some time, a single substance, homogeneous, always the same in its nature, form, and effects; on the contrary, it is an extremely variable body, of diverse chemical composition and physical characteristics; it is not *one* alcohol, but many, which chemists have divided into several series.

The distiller commonly divides the product of his still into three classes: (1) products with a bad taste, the heads; (2) alcohol, properly speaking; and (3) products with a bad taste, the tails. The first and third are kept separate from the middle, which is the most valuable portion. Table I., according to Dr. Rabuteau, gives the boiling points of these different products.

Table I.—Showing the Boiling Point of Different Products.

Products of Distillation.	Boils at—	
	Degrees C.	Degrees F.
Products with a bad taste, the heads:—		
Aldehyde	20.8	69.4
Acetic ether	72.7	162 9
Alcohol, grain spirits, ethyl alcohol	78.0	172.4
Products with a bad taste, the tails:—		
Propyl alcohol	97.0	206 6
Butyl alcohol	109.0	228.2
Amyl alcohol	132.0	269.6
Valerianic ether	133 0	271.4
Amyl acetate and other nameless products	136 0	276 8

Aldehyde is a colorless, easily mobile liquid, having a specific gravity of 0.8009 at 0° C. (Kopp). Its vapor density was found by Liebig to be 1.532, who also states, that, when inhaled in large quantities, the vapors, of a peculiar ethereal suffocating odor, produce a cramp, which for a few seconds takes away the power of respiration. (Isidore Pierre compares its action to that of sulphurous acid.) It is miscible with water in all proportions, heat being evolved, and it is likewise soluble in both alcohol and ether. The addition of water raises the boiling point of aldehyde. It absorbs oxygen, and is slowly converted into acetic acid.[1]

Ethyl acetate or acetic ether is a mobile liquid possessing a penetrating, refreshing smell and a pleasant burning taste. It has a specific gravity of 0.91046 at 0° C. (Kopp). Its vapor density was found by Boullay and Dumas to be 3.016. It mixes with alcohol, ether, acetic acid, etc., in all proportions, and dissolves a large number of resins, oils, and other organic bodies. Its action in many cases, when used as medicine, resembles that of common ether, but it possesses a more agreeable taste and smell. It is also used for addition to the poorer classes of wine, liquors, etc.[1] According to Professor Dujardin-Beaumetz, the toxic dose of aldehyde is from 1 to 1.25 grams, and that of acetic ether 4 grams, per kilogram of the weight of the animal.

Methyl alcohol is the lowest form of the alcohol series, and when pure is a colorless, mobile liquid, having a vinous smell closely resembling that of ethyl alcohol. It has a specific gravity of 0.8142 at 0° C. (32° F.) (Kopp). The boiling point, as stated by various observers, varies from 58.6° to 66.5° C. (137° to 152° F.), owing to the great difficulty of obtaining it in a perfectly anhydrous condition. The difference between the densities of mixtures of methyl alcohol and ethyl alcohol with the same proportions of water is so small that the tables ordinarily used for the latter may be employed for most purposes in ascertaining the strength of the former.

Methyl alcohol is miscible in all proportions with water, ethyl alcohol, and ether. In its solvent and chemical properties it closely resembles ethyl alcohol.

[1] Roscoe and Schorlemmer's Chemistry.

Wood naphtha, pyroxylic spirits, is the name given to the impure commercial methyl alcohol. It is a very complex liquid, containing variable proportions of methyl alcohol, acetone, methyl acetate and formate, allyl alcohol, aldehyde, water, etc. The best commercial wood naphtha contains about 95 per cent of methyl alcohol, the common varieties from 75 to 90 per cent, and sometimes going as low as 30 to 40 per cent. It has a very characteristic odor, and if taken internally will generally produce nausea and other deleterious effects. Pure methyl alcohol, however, is free from these objections. Cases may be cited from the English court reports and daily papers where persons habitually drank methylated alcohol without any other toxic effect than that common to ethyl alcohol.

The higher alcohols, propyl, etc., have a greater toxic effect than ethyl alcohol. Brockhaus has recently personally investigated the effects of propyl, butyl, and amyl alcohols on the system. He found the disagreeable symptoms, giddiness, nausea, etc., to increase with the molecular weights of the alcohols, and amyl alcohol itself proved to be a very violent poison. According to the experiments of Rabuteau, amyl alcohol is fifteen times as intense as ethyl alcohol, and is even fatal in small doses. Amyl alcohol is one of the chief constituents of fusel oil.

An addition of 10 per cent of wood naphtha to ethyl alcohol lowers the boiling point of the mixture 3.3° C. (6° F.) (Ure).

Ethyl alcohol, spirits of wine, ordinary or grain alcohol, is next to methyl alcohol in the ascending order of the alcohol series, is the alcohol on which the internal-revenue tax is levied, and is the alcohol with which most people are familiar. It is a limpid, colorless liquid, of a hot pungent taste, and has a peculiar pleasant smell. According to Mendelejeff, absolute alcohol boils under the normal pressure at 78.3° C. (173° F.), and has a specific gravity of 0.80625 at 0° C. (32° F.) compared with water at its maximum density, 4° C. Dr. E. R. Squibb, of Brooklyn, N. Y., in 1884 obtained alcohol of a specific gravity lower than that recorded by any previous observer, viz., 0.80257 at 4° C., or 0.80591 at 0° C. compared with water at its maximum density. Absolute alcohol, however, is comparatively unknown outside of chemists' laboratories. When we speak of alcohol, we generally mean the liquid that contains from 90 to 95 per cent by volume of absolute alcohol.

Ethyl alcohol is miscible with water in all proportions, a considerable evolution of heat and contraction in bulk taking place on admixture. It is nearly impossible to remove the last traces of water, owing to the tendency of alcohol to quickly absorb moisture from the air. It is a powerful solvent for fluid and solid bodies, both organic and inorganic. It absorbs many gases with considerable avidity. As found on the market, ethyl alcohol often contains traces of higher homologues, of aldehyde and acetic acid, of volatile oils, of various fixed impurities, both organic and inorganic, and is more or less fixed with water.

The tails or faints, as well as the still less volatile or ordinary fusel oil, are mixtures of several alcohols and fatty acid ethers, their relative quantities depending on the nature of the materials used in mashing, belonging to the higher series of alcohols, and consequently possessing greater toxic effects.

Propyl alcohol was discovered by Chancel in 1853 in small quantities in fusel oil obtained in the manufacture of wine-brandy. It resembles ethyl alcohol in its odor. It has a specific gravity of 0.8198 at 0° C., and boils, according to various observers, at from 96° to 98° C. The latter number is probably the correct one, as the boiling points of the normal alcohols increase 19.6° C. for every increment in composition of CH (Grimshaw and Schorlemmer). It is miscible in all proportions with water, but, on the addition of easily soluble salts, as calcium chloride, etc., it separates out from aqueous solutions. Propyl alcohol is not used in the arts or manufactures, but is chiefly employed in scientific research.[1] It is toxically more active than ethyl alcohol; the dose is from 3 to 4 grams per kilogram of the weight of the animal.

Butyl alcohol occurs in varying quantities in several fusel oils, and is especially found in the spirits from beet-root, potatoes, and grain. It was discovered by Wurtz in 1852. It is a somewhat mobile liquid, possessing a spirituous smell, but at the same time a fusel-oil odor, resembling that of syringa flowers. It boils at 108° to 109° C., and has a specific gravity of 0.817 at 0° C. At ordinary temperatures it dissolves in ten parts of water, and the greater part is separated from solution on the addition of easily soluble salts, chloride of calcium, common salt, etc. According to Rabuteau, it is toxically four times as active as ethyl alcohol, its dose being 2 grams per kilogram of the weight of the animal. It has a toxic action on the heart and blood, producing muscular trembling and in large doses convulsive spasms.

Amyl alcohol, so called by Cahours because it was chiefly found in spirits obtained from bodies containing starch (amylum), is commonly called potato spirits. It has been found since to occur in all fusel oils. Amyl alcohol was for a long time considered to be one distinct compound. Biot first drew attention to the fact that this body possesses the power of rotating the plane of polarized light to the left; and Pasteur, in 1855, pointed out that the rotary powers of different samples of amyl alcohol vary according to the source from which they are obtained. From this he concluded that the body termed amyl alcohol is a mixture in varying proportions of an optically active and an optically inactive compound. He succeeded in obtaining the two modifications of the alcohol, and experiments of later investigators have established that they do not possess an identical chemical constitution. Fermentation amyl alcohol is a colorless, highly refracting liquid, possessing a burning taste and a penetrating smell, boiling at 131° to 132° C., and solidifying at —21° C. Inhalation of its vapors produces difficulty of breathing, coughing, headache, and giddiness.[1] It kills rapidly, according to Dujardin-Beaumetz, in doses of from 1.59 to 1.75 grams per kilogram of the weight of the animal. Even in small doses it exerts a powerful effect, bringing about intoxication and coma, producing at first a violent excitement of the nerve centres, followed by depression of the sensitive and motive forces.

Valerianic ether is a colorless liquid, having an irritating taste, and an odor which has been compared to that of apples; it is met with in an extremely small proportion in fusel oils. The same is true in regard to amyl acetate, a colorless liquid of a peculiar and irritating taste, of an odor

[1] Roscoe and Schorlemmer's Chemistry.

that recalls that of pears. Both of these substances have been little studied by chemists.

In short, very complex in their compositions, which are still very imperfectly known, the spirits of commerce not only contain the ethyl, propyl, butyl, and amyl series of alcohol compounds, on which most research has been concentrated, but also a certain number of other products, as pyridin and several aldehydes of unknown composition.

Drs. Laborde and Magnan submitted a report to the French Academy of Medicine, Oct. 21, 1888, giving the results of their experiments with the higher alcohols and artificial bouquets, in regard to their toxic effects on animals, comparing the effects of the natural products with those of the artificial products.[1]

All spirits consist of a more or less diluted ethyl alcohol containing traces of the higher-boiling compounds, commonly called fusel oil, the proportion depending on the care exercised by the distiller in stopping the distillation when the vapor temperature rises above the boiling point of ethyl alcohol, and certain flavoring bodies depending on the material employed. The deleterious effects of raw spirits are attributable to the presence of these higher-boiling alcohols, which, by slow oxidation by exposure to the air, are more or less changed and converted into certain ethers which are comparatively harmless.

All spirits are colorless when first distilled, and if kept in glass or earthenware vessels would so remain; but being stored in oak barrels, the staves of which are generally charred, they gradually acquire a more or less topaz hue. It is therefore the tannin and other extractive matters of the wooden casks that produce the color in all spirits made by distillers. Rectifiers, however, generally use caramel or burnt sugar to color their goods.

Most nations are accustomed to consume alcoholic beverages, and in some of the most barbarous tribes a crude method of preparing alcohol is known. For instance, starchy roots are masticated, then spat into a vessel and allowed to ferment, the resulting alcoholic liquid being drunk with much satisfaction. In Alaska the Indians were accustomed to save up the rations of sugar issued to them by the Government till a sufficient quantity was obtained, when a solution was made with water, compressed yeast added, and the fermentation conducted near their fires, and the resulting alcoholic liquid was strong enough to produce intoxication when drunk in sufficient quantity. This resulted in the Treasury agent stopping the sugar rations.

Table II. shows the percentage of absolute alcohol contained in certain typical fermented and distilled liquors, and the results are the means of many analyses.

That cider should contain more alcohol than ale or porter may be a surprising statement to many readers.

The so-called sweet wines are nothing but artificial, that is, they consist of dry wines adulterated with alcohol and sugar. In Europe there are very stringent laws, in most of the wine-producing countries, against the sale, as wine, of any wine which is not the product of the fermentation of the juice of fresh grapes. All wines made from the second pressing of the marc or grape residue, with the addition of sugar, alcohol, etc., are compelled to be labelled, sold, shipped, etc., as artificial wines. These sweet wines are really diluted brandy sweetened; their alcoholic and sugar contents are nearly equal, and together form about one-half of the volume of the liquid.

[1] Rev. Ques. 4 s., T. 2, 1888, pp. 1369, 1423.

Table II.—Showing the Percentage of Absolute Alcohol in Certain Typical Beverages.

Beverage.	Number of Analyses.	Per Cent Absolute Alcohol.	
		By Weight.	By Volume.
Weiss beer, Berlin	26	2.73	3.42
" " American	28	1.73	2.18
Draught beer	205	3.36	4.20
Lager "	258	3.93	4.93
Export "	109	4.40	5.50
Bock "	84	4.69	5.86
Porter	40	4.70	5.87
Ale	38	4.73	5.91
Cider, American sweet	6	1.40	1.76
" well fermented	7	5 17	6.45
Wine, Europe	1,287	8.41	10.43
" California	130	8.64	10.73
Whiskey, Scotch	—	42.80	50.37
" Irish	—	42.30	49.90
" English	—	41.90	49.40
" American, corn	—	42.50	50.00
" " rye	—	42.50	50.00
" Russian	—	54.20	62.00
Brandy, French	—	47.30	55.00
Rum	—	42.20	49.70
German schnaps	—	37.90	45.00

The different varieties of beer and ale are among the lightest of the alcoholic beverages, the amount of alcohol they contain depending on how far the fermentation of the wort was conducted. In their endeavor to supply a light-colored beer, brewers are resorting to the use of malt substitutes, as glucose, as giving them more satisfactory results,—a practice that presents no objection on the score of health. Such light-colored beers, however, lack the full and fine flavor of a beer made from malt exclusively. In bottling their beer, in order to prevent further fermentation, resort is had to antiseptics, a practice which should be prohibited by law, as the quantity and kind of antiseptic used varies in the different bottling establishments: some brewers and bottlers, however, do not use antiseptics. The use of alkaline bi-carbonates to increase the head of gas is another adulteration of bottled beers. When hops are scarce, and consequently dear, resort is had to other bitters, as gentian and quassia; but that brewers habitually employ unwholesome bitters, as strychnine and picric acid, is extremely unlikely, because, if for no other reason, their sales would decrease on the mere suspicion of such practice. According to the internal revenue law (R. S. 3,337), every brewer is compelled to keep books in which he enters from day to day the kind of malt liquors made, the estimated quantity produced, and the actual quantity sold, and an account of all materials, including grain or malt, purchased by him for the purpose of producing such fermented liquors. At the end of each month the brewer has to send a copy, duly attested under oath, of

such daily records to the Commissioner of Internal Revenue at Washington. If in such returns the employment of unwholesome material was reported, an investigation would be made by the proper revenue officer, and an explanation demanded from the brewer. Thus some sort of check is exercised over the use of poisonous materials. The production of distilled and fermented liquors in the United States since 1863, when a revenue was imposed on the same, is shown, at intervals of five years, in table.

Table III.—Showing Production of Distilled and Fermented Liquors, at Intervals of Five Years, in the United States.

Year ending June 30.	Liquors [1]	(Gallons).
	Distilled.	Fermented.
1863	16,149,954	62,205,375
1868	7,224,809	190,546,553
1873	65,911,141	298,633,013
1878	50,704,189	317,485,601
1883	76,762,063	550,494,652
1888	71,565,486	765,086,789
1890	83,535,165	854,420,264

While the production of distilled liquors has only increased five times, that of fermented liquors is fourteen times, what they were in 1863.

One fluid ounce or half a wine-glass of whiskey, rum, or gin, containing fifty per cent by volume of absolute alcohol, is equivalent in alcoholic strength to five ounces of light red wines, as claret; eight ounces of well-fermented cider; to nine ounces of ale or porter; to ten ounces of lager beer (over half a pint); and to twenty-three ounces of American weiss beer. The intoxicating effects, however, would be more rapid and pronounced in the case of the ardent spirits than they would be with the equivalent amounts of beers, owing to the more concentrated form and consequently quicker absorption in the circulation of the alcohol in the former as compared with its dilution in the latter beverage.

EDGAR RICHARDS.

[To be continued.]

THE STANDARD OF LIVING IN THE UNITED STATES. [2]

IN discussing the standard of living in the United States, I shall consider the producing classes as the people. They constitute the great majority, embody the vital forces of the nation, and represent its life and distinctive character.

An analysis of the conditions which mould the life of the people representing the civilization of the world leaves no room for doubt that the American standard of living is the highest known. The barrier of primogeniture, the repression of caste, the compulsion of social distinctions, are obstructions in the path of ambition which have no existence here. In this country there are no barriers to wealth or station which capacity and persistence cannot sweep away. Physical influences are here in harmony with the intellectual. The western world, in its most temperate zone, with long reaches towards the tropics and approaches towards the north pole, with a breadth bordered by the two great oceans of the world, and spanning practically the possibilities of climate by altitude, is in extraordinary measure independent of other lands. Its resources invite development; and social and political freedom stimulate noblest daring and highest enterprise in their utilization. Here the laborer stands on a relatively elevated plane. If native born, he has no conception of the limitations by which the life of his brother in other civilized countries is restricted. He requires more and better house room, food in larger quantity and greater variety, clothing for his family, books and facilities of education for his children, and something for social life, amusement, and even charities. He is apt to be interested in politics, in social or beneficiary or religious organizations, and oftentimes in all of these. I would not aver that his foreign brother does not possess similar tastes and preferences, but hold that his exercise and enjoyment of them are in more restricted measures, under the limitations of purse and social usages.

Want is not unknown here; the poor and afflicted are everywhere. A comparison with the most favored foreign country will suffice. The Tenth Census returned 66,203 paupers, or 1.32 to every thousand of the population. The record of 1850 was 50,353, or 2.17 to every thousand. This shows a gratifying decrease in pauperism in a period remarkable for increase of national wealth. In England and Wales the number of paupers in 1873 receiving relief in the several unions and parishes under boards of guardians was 887,345, and in 1888 the number was 825,509. The returns do not quite cover the entire population, which was 28,628,804 in 1888, but assuming that they cover all of England and Wales, the number would be 28.8 for every thousand people. This is in violent contrast to the situation in this country.

In the use of food our people are excessive and even wasteful. According to accepted statistics, Great Britain consumes an average meat ration not over two-thirds as large as the American; France scarcely half as large; Germany, Austria, and Italy still less. But the laborer's dietary is improving in those countries. It has already greatly improved in England. The average consumption of meat in the United States is probably not less than 175 pounds per annum. Of other civilized nations, only Great Britain exceeds 100, and many of them scarcely average 50 pounds. The consumption of the cereals, by man and beast, is three times as much, in proportion to population, as in Europe. For the past ten years the average has been 45 bushels for each unit of population, while the usual European consumption does not vary greatly from sixteen bushels per annum. While all is not used as food for man, no small part of it contributes to the meat supply.

The average consumption of wheat for bread is nearly five bushels, and about three bushels of maize and one bushel of oats and rye, or approximately nine bushels for each inhabitant. The average European consumption of wheat is about 3.5 bushels. In the consumption of fruits, the difference between this and other countries is marked with unusual emphasis. Small fruits, orchard fruits of all kinds, and tropical fruits, as well as melons of many varieties, are in profuse and universal daily use in cities and towns, and in the country the kinds locally cultivated are still cheaper and more abundant in their respective localities, though scarce in the regions of recent settlement and those unsuited to a wide range of species. The consumption of vegetables is not excessive.

The American people are no less profuse in clothing than in food. This country is a favored land in fibre production. More than four hundred millions of dollars is the comfortable sum which represents the present fibre product; in the form of cotton, wool, hemp, and flax. There is also experimental production of silk, ramie, sisal, jute, and many others suited to the climate, some of which will ultimately become the foundation of industries. More than half of the material for the cotton factories of the world is grown here, and a third of that is manufactured and mostly consumed at home. If 65,000,000 people require one-sixth of the cotton manufactured in Europe and America for the use of nearly 450,000,000 inhabitants of these continents, and of the millions in India, China, Japan, and other countries obtaining

[1] Under the name of distilled liquors are included whiskey, rum, gin, high-wines, and alcohol; and under the name of fermented liquors are included beer, lager beer, ale, porter, and similar fermented liquors (Ann. Rpt. Com. Int. Rev. 1889).

[2] Abstract of an address before the Section of Economic Science and Statistics of the American Association for the Advancement of Science, at Indianapolis, Ind., on Aug. 20, 1890, by J. Richards Dodge, vice-president of the section.

supplies from the factories of Christendom, the disparity in consumption between this and other countries must be great indeed. With an average *per capita* consumption of 17.5 pounds of cotton, 8.5 of wool, and a large quantity of silk, linen, and other fibres, the claim of superiority in supply of clothing cannot well be disputed. Thus one-twentieth of the population of the world consumes nearly a fourth of the wool product of the world. If the people of Europe should demand an equally liberal supply, the earth might be scoured in vain for the requirements of such a consumption. As they do not, it may be supposed that a larger proportion of cotton would be needed; but a consumption equal to that of this country would not leave a pound for North or South America, Asia, Australasia, or Oceanica. Indeed it would not suffice for more than a supply of 15 pounds per head to Europe alone.

The satisfaction of the dietetic and sartorial demands of our people is no more imperative than the urgency of their requirements for home-making and ornamentation. No able bodied craftsman or skilled laborer, at forty years of age, needs to pay rent for his habitation from inevitable necessity. If he does, it is because of extravagance, mismanagement, dissipation, or peculiar misfortune. There are crowded and unhealthful quarters in New York and other cities, but they are mainly occupied by lower classes of foreigners. Philadelphia, a city of the largest class, with a million of people by no means exclusively native born, has a dwelling-house for every six inhabitants. Washington is equally well provided with homes largely owned by their occupants. There are log-cabins in the South, board dwellings on the prairies, and even "dug-outs" on the plains of the more distant West; but they are temporary expedients of those too busy in opening farms and growing crops to build permanent houses, and too poor to use their scanty capital in expenditures not immediately and largely productive. A glance at the census records of manufacture of furniture and furnishing, of hardware, of heating and illuminating apparatus, of ingenious devices for saving labor and expediting domestic processes, reveals a wealth of suggestion in the lines of comfort and of luxury in building and ornamentation of homes. The fact is gratifying, as it is indisputable, that a large part of this material goes into the houses of the working classes; if not so much of the costly and elegant, at least a large proportion of the tasteful, ingenious, and comfortable appliances of home equipment and adornment. The evidences of prosperity of the producing classes are not seen alone in well furnished homes, but in many forms of profitable investment in real estate, stocks and bonds, and in money savings banks.

The American citizen is not content to exist as a mere animal. Physical well-being does not limit his desire or aspiration. He is especially solicitous for the welfare and advancement of his children, and freely depletes a limited income in their education and training for a career in life, often upon other than ancestral lines. This tendency may become excessive, and is already to some extent, it must be admitted, creating a distaste for useful industry, and a desire for conspicuous position, for accumulation without labor, and speculative rather than productive occupation. Thus the average American lives upon a high plane, exciting the envy or the emulation of people of other countries, and inducing extraordinary immigration.

A high standard of living requires higher wages. While the wages of European artisans and mechanics, and of farm laborers, have advanced in recent times, they nowhere approach very closely the rate of wages received by the same classes in this country. In an extended discussion of the rate of wages in the leading occupations, before the London Statistical Society in 1880, by Mr. J. S. Jeans, it was claimed as a deduction from available statistics that the wages in the United States were 205 per cent higher than in France, 162 per cent higher than in Germany, and 84 per cent higher than in Great Britain. His estimate of the agricultural wages of Great Britain was 12 shillings per week, or about $150 per annum. The average wages of white farm laborers in the United States, as returned to the Department of Agriculture in May of the present year, is $276 per annum, which is 80 per cent above the rate quoted for Great Britain. According to accepted estimates of the rate of wages of men in the principal trades of France, the wages of women in this country are from 60 to 80 per cent higher. A report of the Department of Labor makes the income of women from regular occupations, as averaged from 5,716 returns in 22 principal cities, $295.54 per annum, with $40 average additional income in 682 of the returns.

Land is the freest thing in America. With nine million farmers and farm laborers, cultivating over five million farms, but a third of the land is taken up, but a small part of that is under crops, and the area under nominal cultivation is superficially treated and scarcely up to half its maximum production. Within a few months past there has been an expression of dissatisfaction with the profits of farming, made mostly by political farmers, and relating mainly to the prices of cereals. Cotton brings fully the average price of the last decade, and the last crop was the largest ever grown; still the ferment of dissatisfaction has leavened the whole South. State and national statistics of the last ten years show that agricultural indebtedness has decreased in that region, that the home market is increasing, and that prosperity is more general than ever before; still farmers appear to be unhappy. It is mainly a case of aroused ambition, and a determination to be felt in business, and especially in politics—and it is in these respects a hopeful indication.

There has been much said about farm mortgages,—quite too much. The most reckless exaggerations have been made, and unfortunately have been repeated in legislative halls, and in newspaper interviews and editorials. If the census can obtain the facts, it will show that they have been magnified enormously to mislead the public. All statistical analysis of available data testifies to the truth of this averment. Much the largest proportion of the farm mortgages of the country are for lands and improvements, increase of investment, settlement of estates, and release to sons by wealthy retiring farmers, and are evidences of enterprise and self-reliance and thrift.

Shall the standard of living be maintained? This is a grave question. Upon its maintenance depend the future education, enterprise, independence, and prosperity of the people. It is pertinent also to frame the inquiry, Will it be maintained? for there are influences, from without and perhaps from within, that possibly tend to inevitable lowering of the present standard. Our population has doubled in less than thirty years. There is every reason to believe that it will exceed the present population of Europe before the end of the next century. With five times the present number of people to feed and clothe, can they be fed and clothed as well? It may be, if they continue industrious, if the proportion of non-producers does not increase, if labor shall be distributed harmoniously in production, and if the laborer can secure a just recompense. If the present disregard of the requirements of national economy in production shall continue, if we remain idle at home and go abroad to supplement the deficiencies created by our own inertia, a lower level will be inevitable. Something cannot come from nothing. No nation can consume more than it produces. It is useless to ask what natural productions we can profitably grow. What can we not grow? is a more appropriate question.

As the scale of expenditure must be limited by income, by wages, the rate of wages must be maintained or the standard of living will inevitably be lowered. Without reduction of wages and decrease of cost of manufacture, is enlarged exportation of surplus products possible? If not, it will be better to live well at home, without a surplus, than to live meanly in order to help foreigners to better living.

By comparing our increase of population, to be fed here, with the increase of foreign dependents on our surplus, we find at least twenty new domestic mouths to fill for every one in foreign lands. In the last decade there has been decrease; in the previous one there was considerable increase. Only crop disaster, threatened famine abroad, can enlarge the foreign demand. While our population is enlarging at the rate of nearly two millions per annum, our increase of production will be needed mainly at home, and it is an even question whether the foreign requirements will increase or decrease. It is therefore clearly apparent that the demand for augmented production will come mainly from growth of the population of the United States. This makes the exportation of the

surplus of agriculture a matter of small comparative importance, and of manufacture a minor consideration.

But the record of the growth of exports of domestic manufactures does not warrant the assumption that higher wages are an inevitable bar to exportation. Such exportation in the last twenty years has much more than doubled, while the increase of population was only seventy per cent. There is a constant tendency to greater effectiveness of labor by the acquisition of skill, and especially by inventions and ingenious appliances for the saving of labor.

In certain manufactures, in which the cost of labor has been double that paid by foreign competitors, exports have increased beyond the advance in population, in some cases ten, twenty, even thirty fold. This ability to export, notwithstanding the higher rate of wages, is not as yet general, but there is a possibility, yea, a certainty, of gradual enlargement of the list and especially the volume of exportable goods, partly through superior skill, and efficiency of labor, and perhaps in larger part from labor-saving machines and processes, and from the distinctive peculiarities and marked availability for their intended uses in the manufactured goods. The ability to export, therefore, is less a matter of muscle of the mechanic than of inventive power and of cultivated intellect in the forms and adaptations of the thing manufactured. The higher wages may thus be neutralized by the aid of mind far more than of muscle.

An analysis of the facts that illustrate the standard of living in the United States leads to the inevitable belief that the people, the worker in all the hives of industry, the constructive forces of the nation, exist upon a higher plane than those of any other country. The following results of this investigation are presented:—

1. The American citizen is free from the bondage of feudalism, from the domination of kingly or aristocratic mastery, and from the control of caste. He is an independent individual, a sovereign in his own right, voluntarily submitting to laws of his own making, to limitations of natural rights for the general welfare. His aspirations are checked only by a wise judgment of his capacity, and his elevation in the walks of life is limited only by his ability and opportunity. He is the master of his own career and the maker of his own fortune.

2. Inducements to action lead to activity in effort; intense and persistent application causes waste of tissue, of nerve and muscle; and a liberal ration becomes necessary for repair of waste. The opulence of nature makes rich provision for the largest alimentary liberality. Therefore large consumption of all the elements of nutrition is assured, fully fifty per cent more than that of the average in Europe, and more than twice as much as that of the less favored peoples of the world.

3. The variety and abundance of vegetable and animal fibres, by the favor of soil and climate and the energy of man, are no less remarkable than the range of species and ease of cultivation of the grains and fruits. The development of taste and the effort to rise in social life conspire to create an extraordinary demand for clothing, so easy to gratify, and so increased by the facility of its gratification.

4. It is a natural corollary of these facts, as stated heretofore, that "the satisfaction of dietetic and sartorial demands of our people is no more imperative than the urgency of their requirements for home-making and ornamentation." Liberal demands in food and clothing are only consistent with a high appreciation of comfortable housing. Bed and board are indissolubly joined.

5. Such a scale of expenditure presupposes a higher rate of wages, a larger income than that of average peoples. The facts show that our wages are from fifty to one hundred per cent higher than those of the workmen, in their several classes, of the most favored nations, twice as high as the average of certain countries, and three times as high as that of certain others.

6. With seventy acres of land for every farm worker, three hundred and fifty bushels of cereals for each, with abundant industrial or surplus crops, meats, fruits, and vegetables in equal abundance, and markets greedy for the surplus, the farmer is in condition to live and thrive, or know the reason why his profits do not meet his expectations.

7. The question arises, Shall the present standard of living be maintained? It is a point upon which hang "the future education, enterprise, independence, and prosperity of the people" of the United States. It depends on the industry of the producing classes,—their wisdom in the distribution of their labor towards a production that shall meet their wants. If idleness shall be encouraged, production limited, importation enlarged, and dependence on foreign countries fostered, wages will be reduced, and the ability to purchase, as well as the volume of production, will decline. If the advice of public and private teachers of repressive economy, to buy every thing abroad and sit down in the enjoyment of the luxury of laziness at home, shall become the law of the land, short rations will follow, and high prices will only be abated by the inability of our people to purchase for consumption.

8. If, on the other hand, we determine that there shall be no decline in production, agricultural or other, we must provide for it manfully by our labor, realizing that no nation can live beyond its income, or consume more than it produces.

9. Unless the largest variety of production shall be encouraged, and the highest skill shall be stimulated in the endeavor to meet all the wants of our people by the results of our own labor, it will be impossible to have a surplus for export. The example of Spain and India, in contrast with that of England and Belgium, or of France and Germany, enforces this conclusion. But in view of the fact that high wages must co-exist with a high standard of living, as the history of wages in all countries shows, can we export a surplus produced by high wages? Our experience of the last twenty years shows that our exports of domestic merchandise, produced by the highest wages of the world, have increased much faster than population, some a hundred, some a thousand fold — not because of the fact of high wages, but in spite of it; not so much by the force of muscle as by the creative power of mind. The creations of invention, in the lines of taste and utility, adaptation and expedition, can nullify the obstruction of high wages far more than advance in skill and manual dexterity. It is a matter of time, of determined effort, of high endeavor, to render high wages consistent with large exportation of surplus; but the future will accomplish it, if the present scale of living and rate of wages of the American people shall be maintained.

NOTES AND NEWS.

AT a meeting of the Wellington Philosophical Society, New Zealand, Mr. Hulke exhibited a spider that carried its young on its body without web or filament until they were able to run.

—Sponge would seem to be an unpromising material for a sculptor to work upon; but that a work of art may be chiselled, or rather scissored, from it is proved by a life-size statue in sponge now in the sponge department of McKesson & Robbins, wholesale druggists, on Fulton Street, this city. The statue represents a Greek sponge-gatherer standing in the bow of a boat, pole in hand, gazing intently through a water-telescope at a piece of sponge which he is supposed to be endeavoring to secure. The figure is composed of numerous pieces of what is known as leathery potters' sponge, carefully matched as to color, texture, and shape, so that the statue appears to be cut from one large sponge. The artist has done his work well, the face especially being an excellent piece of carving.

—Professor T. Hirsch, reporting for the Committee of the Mechanic Arts of the "Société d'encouragement pour l'Industrie Nationale" of France, at the meeting of July 11, states that the committee has analyzed the work of M. Dwelshauvers-Dery, and finds that "the method of calculation proposed by him is at once original, and fruitful of results. In its application to the experiments of Mr. Donkin, its author demonstrates the course to take in computation, and thus facilitates the work of all those who desire to study such questions. It constitutes an important advance in the study of such complex phenomena as those of which the steam-engine cylinder is the seat." The committee proposed very hearty thanks from the society to the author of this work; they were accorded, and the memoir of M. Dwelshauvers-Dery was directed to be inserted in the bulletin *in extenso*.

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VOL. XVI. NEW YORK, SEPTEMBER 5, 1890. No. 396.

CONTENTS:

HEALTH MATTERS.

Should Beer be drunk out of Glass?

THE Boston *Medical and Surgical Journal*, quoting from a German industrial periodical, says that a spirited contest has for some while been waged in Germany between the beer-glass and the stone-mug factions. Dr. Schultze claims to have established, by a very extended series of experiments, that beer, by as little as five minutes' standing in any glass, even when cold and in the dark, will be materially affected both in taste and odor. He sustains his claims by trial tests confirmed by some one hundred persons. The change, he thinks, is due to the slight solubility of the glass substance in the beer. This is of further importance from the fact that the glass most generally used contains lead, which has been added for its better and more easy manipulation in manufacture. From a series of experiments made upon glasses obtained from the leading sources of supply, he determined that one cubic centimetre of beer, by five minutes' standing in glass, dissolved 6 to 26 ten-millionths of a milligram of the glass substance containing 0 to 48 thousand millionths of a milligram of lead-oxide. This small quantity of glass substance he claims affects the taste of the beer, and, if it also contains this lead, renders it objectionable from sanitary reasons. He recommends for use as a normal test drinking vessel, whereby one can surely and easily determine the fitness or unfitness of any other vessel, a silver mug gilded upon its inner surface, the beer to be first tasted out of the silver mug, and then out of the other vessel. He gives the following comparative scale of fitness for beer vessels as made out of different material: All lead-glazed mugs are to be wholly excluded. Covered salt-glazed stone mugs he ranks as good, but tin ones as better, and gold-lined silver mugs as the best. Hard lead-free glass he ranks as poor, but soft-pressed glass as still poorer, and poorest of all lead glass, either pressed or blown. Porcelain, even that made at Meissen, he thinks not serviceable. Wood mugs are doubtful on account of the pitch varnish, which, even if it should not flavor the beer, yet is liable to induce loss of sleep and headache.

Dr. Schultze's conclusions have been discussed and disputed by Professor Linke, he claiming that, according to Schultze's own showing, 20,800 litres of beer out of the very worst kind of lead beer glass must be drunk within fifty-seven years, in order to take in even one milligram of lead-oxide into the body of one drinking a litre of beer a day. From an average quality of lead glass, it would take 74,000 litres and two hundred and three years to accomplish the same. Moreover, he claims that Schultze's lead quantities are seventy-six times too great, and that therefore it would require that much longer time to imbibe that small amount of lead.

A New Butter Substitute.

According to the Boston *Medical and Surgical Journal*, M. Heckel and Schlagdenhauffer have discovered and reported upon a certain Spanish broom-like bush, native of the west coast of Africa, which belongs to the Polygala family, and to which they have given the specific name of butyracea. The native name of the bush is Malonkang or Ankalaki. Its seeds yield 17.5 per cent of a yellowish butter-like fat of a very agreeable nutty flavor, and which could well serve as a substitute for butter. The fat softens between 28° and 30° C., beginning to melt at 35°, but does not become fluid below 52°. Upon cooling, it remains fluid for a long time, only beginning to solidify at 33°, when it regains its original consistency. Its density at between 35° and 38° C. is 0.904. It saponifies very easily with alkalies, and contains 31.5 per cent olein, 4.8 per cent free palmitic acid, 57.54 per cent palmitin, and 6.16 per cent myristin. It contains small quantities of formic and acetic acids, but no butyric or valerianic acid, and therefore it does not easily become rancid.

Is Fair Hair becoming Extinct?

The *British Medical Journal* concludes an article on hair as follows: "On various grounds, therefore, it would seem as if the fair hair so much beloved by poets and artists is doomed to be encroached upon, and even replaced, by that of darker hue. The rate at which this is taking place is probably very slow, from the fact that Nature is most conservative in her changes."

Denicotinizing Tobacco Smoke.

According to the *British Medical Journal*, Dr. Gautrelet, of Vichy, claims to have discovered a method of rendering tobacco harmless to mouth, heart, and nerves without detriment to its aroma. According to him, a piece of cotton wool steeped in a 5 to 10 per cent solution of pyrogallic acid inserted in the pipe or cigar holder will neutralize any possible ill effects of the nicotine. In this way not only may the generally admitted evils of smoking be prevented, but cirrhosis of the liver, which in Dr. Gautrelet's experience is sometimes caused by tobacco, and such lighter penalties of over-indulgence as headache and furring of the tongue, may be avoided. Citric acid, which was recommended by Vigier for the same purpose, has the serious disadvantage of spoiling the taste of the tobacco.

LETTERS TO THE EDITOR.

Source of the Rocky Mountain Precipitation.

IT has often been a question whether more of the moisture of Colorado came from the Gulf of Mexico or from the Pacific Ocean. The fact that the rivers that drain the western slopes of the Colorado mountains, such as the Yampa, the White, the Grand, and the San Juan, are larger in the aggregate than the streams that flow eastward, is proof that the Pacific is better watered than the Atlantic slope. Most of this precipitation occurs during the winter as snow. The snow-fall rapidly increases as we

go from Central Utah, at an elevation of 4,500 feet, north and eastward to the high mesas of the Yampa and White Rivers, at an elevation of 8,000 to 10,000 feet, where several feet of snow cover the ground for two or three months. In that region during the great snow-storms the wind usually blows from the south or south-west. Some precipitation occurs on a north wind, but it is preceded by west or south-west winds. It thus becomes evident that the precipitation on the western slope of the mountains is chiefly derived from the Pacific. Where does the moisture come from that falls on the eastern slope?

The larger part of the precipitation on the eastern slope of the mountains takes place while the surface wind is blowing from the north or some quarter from the eastward: hence it has often been stated that this is Atlantic moisture. Doubtless much of it comes to us from the Gulf of Mexico by way of the Great Plains, yet in most cases it is easy to prove there has been a large supply from the Pacific.

First as to the storms of the colder months from October to May. These storms usually cover large areas. The precipitation is from stratus or cumulo-stratus clouds moving over the mountains. Several days of south-west wind in most cases precede the shifting of the wind into the north or some eastward quarter, at which time the precipitation takes place. During some of these storms the wind blows from some westward quarter for several days, so that it is often certain that sufficient wind has passed eastward to permit air direct from the Pacific Ocean to reach eastern Colorado and the Great Plains. As the storm-centre advances, this same air must often be deflected backward toward the mountains. It is obvious that in the case of cyclonic storms there is an influx of air from the west (the "Chinook" winds) in the region south of the storm-centre. In the larger storms the distance travelled by the wind is so great as to permit air direct from the ocean to cross the mountains.

Occasionally storms break upon us without the premonitory south-west winds. Thus a blizzard struck south-eastern Colorado Oct. 30, 1889. The winds had been light and variable. Suddenly the wind shifted into the north to north east, and for several days raged at a high velocity. There was a heavy precipitation of snow, and not even the rotary snow-ploughs could keep the railroads open for travel. Several thousand miles of wind from the direction of the plains and Missouri valley were driven obliquely up the slopes of the mountains. The signal maps show that the storm-centre passed north-eastward over northern Texas, and the area of west winds was far south of here. Over Mexico and Texas there must have been a large movement of Pacific air eastward.

Second, the summer thunder-storms. These also are preceded by west to south-west winds. In general, the longer the west winds continue, the more violent will be the storms when the final break-up comes. A common type of development of the July storms is the following. Warm winds begin to blow from the south-west, and continue four or five days. The temperature becomes progressively hotter. Some day we see a cumulus-cloud over the mountains begin to throw out filmy streamers above and a fringe beneath. It rains a little above timber-line, and there may be a discharge of cloud-lightning. Then, as the cloud passes eastward over the plains, it loses its ominous fringe, and becomes an ordinary sleepy cumulus with a sharply defined edge. Next day the attempt at a storm is repeated, the fringe is longer and the cloud is larger, but the ranchman who is wishing for rain looks on in disgust at the abortive effort, and remarks that there is a lack of ginger in the upper air. Meantime the general movement of the lower mile or two of the air continues from the south-west. After a few more days of failure, we some day see high cirrus streamers and films begin to form before noon. Soon after, there are big cigar-shaped masses of cirro-stratus far below the cirrus. Still farther below are innocent-looking cumulus-clouds with rather definite margins. As the afternoon advances, one of these begins to bristle with an indefinite fringe above and below. The fringes grow longer. Presently a marginal belt of rounded festoons appears outside the central fringes and beneath the storm-cloud, while above it the high streamers radiate outward in the sheaf-of-wheat pattern. In the mean time a halo, or part of one, has appeared around the sun in the higher filmy clouds. Before midnight there will be hail and cloud-bursts on the mountains, and these storms will go hundreds of miles eastward onto the plains. It often happens that the first storms go northward or north-eastward. The next day they shift toward the west. In a few days they will come from the north-west or north. Then the air will be cool, the general movement of the air is from the north, and there will be no more storms until after another season of south-west winds.

Thus the summer showers, as well as the winter storms, derive most of their moisture from the Pacific. There are different types of these local electrical-storms, but they all are alike in one respect: they appear as local disturbances in the midst of an area of relatively heated south-west or west winds.

The present summer has been remarkable for the amount of Pacific air. Heretofore, during several years of observation, the wind has never been known to blow briskly from the south-west for more than one to three weeks without the formation of some kind of storm, or at least attempted precipitation, which interrupted the west wind.

This year, during late May, June, and July, there were more than two months of almost constant wind from the south-west over the mountains. It should be noted that the wind in the valleys, near the base of the mountains, is often variable, and there are local movements this way and that, while all the time the clouds on the mountains show that the wind is there from the south-west. Several thousand miles of air fresh from the heated regions of Southern California, Utah and Arizona, have passed eastward over the mountains. Hot weather prevailed simultaneously over eastern Colorado, Kansas, Missouri, and eastward. Such a movement I have not noticed before in eight years of observation. The thunder-storms have this year been late in forming in Colorado, notwithstanding the great supply of Pacific air. For nearly two months the clouds seemed to be at a rather low level in the air, and there was much less of the high cirrus than usual. No solar halos appeared till about the middle of August. Their appearance was followed by very violent hail-storms and wash-outs. In short, we appear for once to have had for most of the summer too much Pacific below, and too little Arctic up above.

It is noticeable that the tornado belt this summer lies far to the north and east. Is not this the result of the vast body of Pacific air which has invaded the Mississippi valley? It appears as if for some cause the meeting-ground of the warm and cold currents had, during the early summer, been pushed north-eastward to the line from Minnesota to New England, instead of the ordinary Missouri-Ohio line. G. H. STONE.

Colorado Springs, Aug. 23.

Professor A. Graham Bell's Studies of the Deaf.

I AM always ready to welcome intelligent criticism of my labors on behalf of the deaf; but the articles published in *Science* (Aug. 15, pp. 85–88; Aug. 29, pp. 117–119) from the pen of Mr. W. J. Jenkins unfortunately contain so many misstatements of fact as to render reply distasteful.

Mr. Jenkins commences his criticism (p. 85) by "entering a gentle protest" against the truth of a statement I never made; and he ends it (p. 119) with a long paragraph containing a series of statements relating to the census of 1880, no one of which is correct. The intervening matter is so full of inaccuracies, that I should take up a great deal of your valuable space were I to attempt to point them all out.

His chief objective is an attack upon what he calls my "theory of a deaf-mute variety" (p. 85); but he nowhere states exactly what this theory is, so as to enable your readers to judge for themselves whether or not his attack is well founded. Let me therefore supply this deficiency.

The theory referred to is contained in a paper, "Upon the Formation of a Deaf Variety of the Human Race," which I had the honor of reading before the National Academy of Sciences, Nov. 13, 1883 (see *Memoirs of the National Academy of Sciences*, vol. ii. pp. 177–262).

In the preface (p. 180) the theory is formulated as follows: "If the laws of heredity that are known to hold in the case of animals

also apply to man, the intermarriage of congenital deaf-mutes through a number of successive generations should result in the formation of a deaf variety of the human race." For example: let some of the congenitally deaf marry congenital deaf-mutes; then let some of their deaf children marry congenital deaf-mutes, and some of *their* deaf children marry congenital deaf-mutes, etc., then the percentage of deaf children born of such marriages will increase from generation to generation, until finally all, or nearly all, of the children will be born deaf. The families of which this would be true would then constitute a variety of the human race in which deafness would be the rule instead of the exception.

Now, Mr. Jenkins is greatly exercised over the fact that all the distinguished scientific men whose opinions are quoted in the little pamphlet entitled "Facts and Opinions relating to the Deaf," admit this theory to be true. He gets over the difficulty, however, when he discovers that these gentlemen all belong to a scientific association of which I also am a member; and he says, "A member of their own fraternity has asked them their opinion on a theory of his own formulating; and, in complimentary deference to a great name, they have indorsed the theory."

I need make no further comment upon this than to say that the "fraternity" refers to no less a body than the National Academy of Sciences; and that the gentlemen who are so willing to subordinate their real opinions out of complimentary deference to me are Professor Edward D. Cope, Professor Alpheus Hyatt, Dr. H. P. Bowditch, Professor William H. Brewer, Professor Simon Newcomb, and Professor W. K. Brooks.

But to all his numerous mistakes Mr. Jenkins puts a climax when he credits the above theory to me. Such an error might be pardonable in one not connected with the Hartford School for the Deaf; but it is surely unpardonable that Mr. Jenkins should not know the author of the theory to have been the principal of the very school in which Mr. Jenkins himself is an instructor.

In my "Memoir" (p. 196) I quote the words of the late Rev. W. W. Turner, as follows: "It is a well-known fact that among domestic animals certain unusual variations of form or color which sometimes occur among their offspring, may, by a careful selection of others similar and by a continued breeding of like with like, be rendered permanent, so as to constitute a distinct variety. The same course adopted and pursued in the human race would undoubtedly lead to the same result. . . . Early consideration of philanthropy, as well as the interests of congenitally deaf persons themselves, should induce their teachers and friends to urge upon them the impropriety of intermarriage" (from a paper upon "Hereditary Deafness," published in 1868; for further references see my *Memoir*, p. 196).

The above is the theory for which I have so often been denounced. But the statistics of the "Memoir," to which alone I can lay claim, and which have led me to fear that a deaf variety of the human race is actually in process of formation in America, have never been seriously questioned.

Many statistics have since been collected by deaf-mutes themselves, and by their teachers, to show that there is no cause for alarm; but their figures all demonstrate that the percentage of deaf offspring born of deaf-mute intermarriages is many times greater than the percentage of deaf offspring born of the marriages of those who hear.

The testimony of the present principal of the Hartford School, Mr. Job Williams, is specially strong upon this point, although it is adduced to sustain the opposite contention (see *Facts and Opinions*, pp. 42–50).

In view of these facts, we cannot but note with alarm that many of the most prominent teachers of the deaf in America advocate the intermarriage of deaf-mutes. Dr. Philip G. Gillett, superintendent of the Illinois Institution for the Education of the Deaf, says (*Facts and Opinions*, p. 53), "I do not discourage the intermarriages of the deaf, as they are usually more happily mated thus than where one of the parties only is deaf. The deaf need the companionship of married life more than those who hear, and it is a gross wrong to discourage it."

Dr. Gillett is probably the oldest teacher of the deaf in America, —not oldest in years, but oldest in service,—and he is looked up to as a guide by very many in the profession.

Much good might arise from a comparison of views between Dr. Gillett and those scientific gentlemen who have given most attention to the subject of heredity. May I ask him, through the columns of *Science*, what would be his advice in such a case as the following?—

A young man (not a deaf-mute) became deaf in childhood while attending public school. He has one brother who is a deaf-mute, and another who can hear. Two others of the family (believed to be hearing) died young.

The father of this young man was born deaf in one ear, and lost the hearing of the other subsequently from illness. He had a congenitally deaf brother who married a congenital deaf-mute and had four children (three of them congenital deaf-mutes).

The mother of the young man was a congenital deaf-mute, and she also had a brother born deaf.

The paternal grandmother of the young man was a congenital deaf-mute, and she had a brother who was born deaf. This brother married a congenital deaf-mute, and had one son born deaf.

The great-grandfather of this young man (father of his paternal grandmother) was a congenital deaf-mute; and he was, so far as known, the first deaf-mute in the family.

Thus deafness has come down to this young man through four successive generations, and he now wants to marry a congenital deaf-mute.

The young lady has seven hearing brothers and sisters, and there was no deafness in her ancestry, but she herself is believed by her family to have been born deaf.

Dr. Gillett must not think that this is a purely hypothetical case, for it is not. The parties are engaged, but the marriage has not yet been consummated, and I know that Dr. Gillett's advice would have weight with the young people.

The teacher of the young lady has been consulted, and she feels her responsibility deeply. Her heart is with the young couple, and she desires their happiness, and yet her judgment is opposed to the union.

Will Dr. Gillett tell us what his advice would be in such a case?

ALEXANDER GRAHAM BELL.

Washington, D.C., Sept. 1.

Treatment of Snake-Bites.

IN *Science* of Aug. 22, 1890 (p. 107), it is stated that Professor Kaufmann strongly condemns the use of large quantities of alcohol in the treatment of snake-bites, as he thinks it paralyzes and depresses the nervous system.

Now, this paralyzing and consequent depressing effect of alcohol in snake-bites is just wherein its medicinal or remedial value lies; for by this paralyzing effect, tissue change and general metamorphoses of both the solids and fluids of the body are retarded, and the reactionary susceptibility of the system is blunted and benumbed; so that the venom is more slowly fed into the system, which is, by the paralyzing effects of the alcohol, rendered less susceptible to disturbing influences. Thus the *vis medicatrix naturæ* is given more time in which to eliminate, and in smaller quantities, the venom from the system.

This is another striking proof of the truth of the ancient aphorism, "Do not allow your theories to interfere with your practice."

Q. C. SMITH.

Austin, Tex., Aug. 26.

Temperature in Storms and High Areas.

ONE of the first practical discussions of this question was published in 1886 by M. Dechevrens, of Zikawei, China, and a translation of this paper will be found in the *American Meteorological Journal* for August, 1886. An independent investigation of this same question was carried on in this country before the above publication, the results of which will be found in the journal quoted above for October, 1887. The latter study showed that the temperature fluctuations were almost exactly the same, and had the same phases, both at the base and summit of high mountains, which was exactly opposite to the results obtained by M. Dechevrens. Dr. Hann of Vienna espoused the cause of M. Dechevrens, and tried to show that the observations at Sonnblick indicated the

same effect. Inasmuch as these two foreign discussions reached conclusions directly contradictory to all the teachings of meteorology, the importance of determining where the error lies, and of establishing the truth, will readily be seen.

A careful study of the question will show that the entire difficulty, and apparent contradiction, has arisen from a neglect of the consideration that at considerable heights in the atmosphere a lower temperature has a tendency to contract the air and cause a diminution of pressure, and a higher temperature just the reverse. The best example of this is to be found at Pike's Peak (14,134 feet), where the lowest pressure ever recorded was 16.88 inches, on Jan. 20, 1883, while the temperature at the summit was—34°, and while a high area of great magnitude was passing at the base. This shows that we must ignore fluctuations in pressure at the high station, and consider only those below. When this is done, the whole difficulty vanishes at most stations. Dr. Hann seems to have found a few cases where an increase of pressure at the lower stations near Sonnblick has been coincident with an increase of temperature on the mountain 8,700 feet above. It may be well to pursue this discussion under a slightly different form, and unite the results as obtained at Mount Washington (6,279 feet) with those in Austria.

The plan proposed is simply to compare side by side the temperature fluctuations at both base and summit. If we had balloon observations at 10,000 feet and others at sea-level on the earth's surface, such comparisons could be made readily and accurately; but it should be noted that when we use mountain observations, especially those on ranges and not isolated peaks, we cannot hope for an absolute comparison. The difficulty will be enhanced if our base station lies at some distance from the mountain, though in the case of an extended range we may obviate some of this source of error by taking stations on both sides of the range. It will be universally admitted that, north of the equator, the usual fluctuations of temperature at sea-level on the passage of storms and high areas are perfectly well known, though these may at times be masked or even reversed, as, for example, when the centre of the storm passes just a little south of the station. In general, as a storm comes up, there is a southerly breeze and a great increase of temperature. This increase of temperature is observed even though there be a calm and the sky be clouded, hiding the sun's direct rays. We naturally conclude that this heat condition is an accompaniment of the storm, and is largely independent of the sun's direct influence in raising the temperature. Exactly the reverse of this is experienced when a high area or a clearing condition approaches a station. Here the sky is perfectly clear, and though the sun has apparently a much better opportunity to heat up the earth and air, still we find a marked lowering of temperature. This is the normal condition, but suppose we find that with the increased pressure there is increased temperature at sea-level, or that the clouds come up and there is rain, then we must conclude that the conditions are abnormal, and in any general discussion or comparison of temperature conditions at the base and summit of a mountain we must give such cases a separate study and not unite them with the normal fluctuations. It seems quite plain that we may draw curves showing the observed temperatures at base and summit, and compare them directly. There is a slight difficulty, however, which must first be overcome, and it is this. At the earth's surface there is a marked daily effect from the sun's direct heat which generally causes a steady rise of temperature from sunrise to about 3 P.M., and this would mask the other conditions. It would be a great advantage if we could use observations more than once a day, as the maximum point in the passage of a storm and a minimum point in a high area might occur at any hour of the twenty-four. One way of eliminating this diurnal range would be to apply the difference between the monthly mean and the mean for any hour to each daily observation of that hour; for example, we would have to add a little to nearly every sunrise observation and subtract from nearly every maximum observed; but a better way still would be to take the mean of the hour which agrees most closely with the mean for the day and apply the difference between that and the hourly mean to each observation, as this would save one-third of the labor when we are studying three observations each day. In the latter case the 9 P.M. observation, for example, would be projected without modification. In projecting the temperature curves it was found most convenient to use the night observation rigidly and to interpolate the morning and afternoon observations if either or both differed widely from that. For Mount Washington the station at Burlington was chosen for the base until it was closed in 1883, and after that Portland. After projecting the curves there was found to be a most extraordinary similarity between the changes at the base and summit. To illustrate this I have drawn Fig. 1, which gives the fluctuations for January, 1876. I think this will be recognized as a perfect accordance. The slight hitch on the 16th on the summit has only a very slight bending at the base, but it is noticeable. Such slight coincidences were ignored in the summing-up. In the 78 colder months there were 1,128 accordances out of 1,240 cases, or 91 per cent; and in the warmer months, April, 1873, to September, 1879, 42 months, there were 553 accordances in 601 cases, or 92 per cent. It would seem that even if there were no explanation for these few discordances, the evidence is conclusive that whatever fluctuations of temperature take place at the base, they are faithfully repeated at the summit. The comparison will seem all the more effective when we reflect that this thin strip between these curves represents a difference in vertical height of over 6,000 feet.

I have made a careful study of the discordances, and find that they can all be explained under the following heads: (1) Often the curve turns at the summit before it does at the base, or, in other words, a lagging at the base causes the summit curve to cross that at the base. (2) At other times there is an abnormal condition of the upper atmosphere, a fall of rain, for example, in the centre of a high area, which shows a remarkable disturbance of temperature conditions. (3) There is sometimes in a high area a perfectly clear sky, which promotes intense radiation from the soil at the base, but which has no counterpart at the summit. For example, during the progress of a high area which culminated at 4 P.M., Nov. 16, 1874, the following temperatures were observed:—

	15			16			17		
	7 A.M.	4 P.M.	11 P.M.	7 A.M.	4 P.M.	11 P.M.	7 A.M.	4 P.M.	11 P.M.
Burlington...........	28°	35	37	40	36	31	36	44	46
Mount Washington..	13°	19	18	15	15	22	23	27	30

Here the minimum temperature at the summit was reached during the afternoon of the 16th, but the great radiation after dark at the base gave a minimum at that point at night, though it is also probable that a portion of this was due to a lagging at the base. (4) There are occasions in the centre of a high area, which has only a very slight onward motion, when the sun's heat appears to have an abnormal effect upon the air column, causing an increase in temperature at the summit above that at the base. In all the cases examined there were only two under this last head. There is no difficulty at all in explaining all the exceptions, and these may fairly be said to *prove* the rule. The evidence is overwhelming that if the principles just laid down are accepted there is a marked increase in temperature at 6,000 feet height in our storms, and a decrease in our high areas.

It is a very interesting fact that the distance between the curves at the base and summit of Mount Washington during the passage of storms and high areas seems to be nearly constant. The slight crowding on the right-hand side of the curves between Nov. 6 and 11, and 26 and 30, is due to the fact that the base is to the northwestward of the summit, and hence the latter lags behind a little as a storm moves to the east. Does not this similarity prove that there is no uprush of air in the storm, nor a downrush in the high area?

To complete this investigation it is necessary to make a similar study of the observations used by Dr. Hann in arriving at his conclusions. It should be borne in mind that Sonnblick, the mountain station used by Dr. Hann, is almost entirely outside of the

track of storms and high areas. Mount Washington, that we have just studied, lies almost directly in the path of storms that cross the United States, and a little to the north of the ordinary path of high areas. Sonnblick is also on a long range of mountains, and not an isolated peak. The nearest base station on the north side is Salzburg (53 miles), and on the south side Görz (100 miles). The difference in height between Sonnblick and Salzburg is 8,722 feet, which is not quite one-half greater than Mount Washington above Burlington. On projecting the temperature curves at these Austrian stations we are struck at once with the

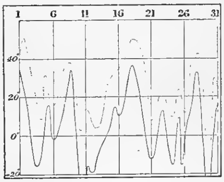


FIG. 1.

Full curve, Mount Washington; dotted, Burlington. Vertical lines are at intervals of five days, horizontal lines at each twenty degrees Fahrenheit.

enormous difference in the character of the curves. I have shown, as compared with those in this country, the curves for the month of March, 1888 (Fig. 2). We see at once that there is a marked similarity in the bendings of the curves; but the fluctuations are very moderate, and do not have sharp points, as was to be expected from what has already been said. One of the more marked discrepancies in Fig. 2 occurs on the 26th, which shows a deep depression at Salzburg, and none at Sonnblick. On projecting the temperature curve at Görz (shown broken in Fig. 2), we see that the curve for Sonnblick coincides exactly with that at Görz. This is a very significant fact, and shows that the mountain range is a serious drawback to a study of this question from these observations. Taking out all the coincidences, we may say

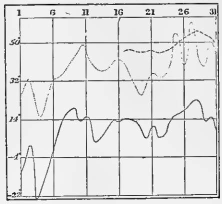
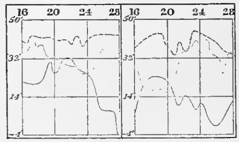


FIG. 2.

Full curve, Sonnblick; dotted, Salzburg; broken, Görz.

there are about 75 per cent fairly satisfactory, though hardly more than 50 per cent, perhaps, as marked as at Mount Washington. I think these discrepancies are due to the causes already set



November, 1889. December, 1889.

FIGS. 3 AND 4.

Full line, Sonnblick; broken, Görz; dotted, Salzburg.

forth, and certainly sink into utter insignificance when compared with the coincidences at Mount Washington. There are two quite interesting discordances in the whole set of curves, and

these are of enough importance to merit a separate discussion. Figs. 3 and 4 exhibit these cases. It will be clearly understood that these are the most serious discordances in the records for more than three years and a half. If it is possible to explain or elucidate these cases, we have practically attained the same result in Austria that we found in this country. During both these periods a high area of great magnitude and persistency settled over this region. We have no similar phenomena in this country as this of high areas (30.7 inches) remaining over one spot for ten days or a fortnight. In Fig. 3 there is no marked fall in temperature at Salzburg; and at Görz, on the south, the curve is almost flat. If we could shift the Sonnblick curve five days later, we would have an almost exact accordance between that and Görz, though I do not insist that that is a necessary view to take. When we look at Fig. 4 we see that there is an exact accordance between the Sonnblick and the Görz curve for a part of the way, and with Salzburg for the rest, so that here all the difficulty disappears at once. We may well believe that in this mountain region there will be great irregularities in the effect of the sun upon the earth and atmosphere. During the prevalence of such high areas the air becomes almost calm and stagnant, and it is an open question whether under these conditions the sun may not have a strong effect at the higher station during the day-time, while the radiation at night would be very much less than at the base; and hence there may be a steady accumulation of heat at the upper station, while at the lower the curve would be nearly horizontal or slightly depressed. It should be noted that while with the progress of ordinary high areas there may be a fall of 20°, and even 40°, at the base, yet in these cases it was very much less, amounting to less than 10° in November.

It is realized that this is merely a beginning in this discussion, and it is hoped that others will take it up, for it is all-important that this whole question be settled. H. A. HAZEN.

Washington, D.C., Aug. 26.

AMONG THE PUBLISHERS.

THE D. Van Nostrand Company have issued, as No. 98 of their Science Series, "Practical Dynamo-Building for Amateurs," by Frederick Walker. In this little volume the construction of a dynamo is described in detail so carefully and clearly that any intelligent amateur, skilled in the use of tools, will have no difficulty in producing an efficient machine wound for any desirable output. The book is the first American edition of the work, carefully revised from the second English edition.

—Dr. J. M. Mills of New York has been for several years studying the relation of eye-strain to headaches, etc., among children, and publishes a summary of his findings in an illustrated article in *Babyhood* for September. There appears to be no doubt that cases of short sight, far sight, and irregular sight often go unrecognized until the continued eye-strain results in a chronic headache and lassitude, or even serious nervous disorder. Other articles in the same issue are "Malaria," "Helps for the Fretful Baby," "Occupations and Amusements," and questions and answers upon subjects connected with the diet and clothing of children.

—A work in two quarto volumes, on "The Fossil Insects of North America," by Dr. Samuel H. Scudder of Cambridge, will be issued early in October by Macmillan & Co. The two volumes, of which only one hundred copies will be issued, not only contain, with some slight exceptions, a description of all the species of fossil insects of all American strata so far as known, but practically include the entire body of literature on this topic. The work will be illustrated by about sixty full-page plates, and occasional figures in the text. An English translation by Dr. George McGowan, of Professor Ernest von Meyers's "History of Chemistry," is announced for early publication by the same firm; also (in September) an illustrated work by Dr. R. W. Shufeldt of the Smithsonian Institute, entitled "The Myology of the Raven, a Guide to the Muscular System of Birds."

Attention has been called in various quarters (England, Belgium, France, and Germany) to the remarkably cold weather prevailing of late years, since 1885, in central and western Europe, the yearly averages being constantly under the normal. It now appears from an Algerian record that these years have been warmer than usual in Algeria. It is also shown that there has been no change in the frequency of north and south winds, while in Europe the north-east winds have been increasing in frequency.

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EIGHTH YEAR. VOL. XVI. No. 397. NEW YORK, SEPTEMBER 12, 1890. SINGLE COPIES, TEN CENTS. $3.50 PER YEAR, IN ADVANCE.

CORNELL UNIVERSITY AND HER TECHNICAL DEPARTMENTS.

SOME years ago we gave some account of the organization of Cornell University, the "land grant college" of the State of New York, and the seat of those colleges of agriculture and the mechanic arts the support of which is the prescribed "leading object" of its foundation and maintenance, while it is still permitted and expected to offer suitable courses of liberal and academic education. Since the date of that article (*Science*, x. 158, Sept. 30, 1887), great progress has been made in all its departments, and especially in those in which we are particularly interested; and we take advantage of an opportunity which presents itself at the moment to exhibit something of this progress and the present condition of the technical school having most interest to our readers.

Five years ago there were about six hundred students in the University, of whom perhaps a third were engaged in technical studies, while the schools of useful arts were very slowly growing into form. With the increase of the income of the University due to the final harvesting of those financial returns coming of the earlier seeding and care of Cornell and his eminent successors on the board of trustees, and the generosity of Cornell, McGraw, H. W. Sage, Hiram Sibley, A. D. White, and other equally zealous if less able friends, an extraordinary growth began, and has continued uninterruptedly up to the present time; and we now propose to show what has thus far been effected. The reputation of the University is to-day so far assured that the requirements and the charges for tuition have been purposely made a bar to further growth, except at a moderate rate, the trustees evidently desiring quality rather than quantity; while their funds are now taxed to the utmost to afford those new buildings, and to secure those additions to the equipment, which are necessitated by such rapid progress. The University registered, in 1889–90, 1300 students, of whom about one-half were engaged in technical studies; and of the others, the largest body were taking the course in arts, the most thoroughly classical of the many courses offered. Of these, also, some go, later, into technical work; and it is becoming very common, and more and more so, for young men proposing to go into the engineering professions especially, to first secure a liberal education. They find the advantage, both in college and later, to more than compensate the time thus demanded in addition to that required for the technical course alone. Such students often take their electives, in the senior and junior years, largely in mathematics and the sciences, and thus practically lose often but two years in attempting the double course.

The changes with which we are now concerned affect mainly the technical end of the campus; for the growth, though large in other departments, has been so much more in these lines of work that the construction marking material changes has mainly occurred there. It is now, however, expected that the law-school and the academic departments must soon illustrate in turn this extension of the growth of Cornell. The agricultural department is waiting for a patron to give it a new building and enlarged equipment, but it is not yet ready to fill much more space with its students.

A bird's-eye view of the campus from the north-west, over Cayuga Lake, would show the sixty acres of beautiful lawn besprinkled with buildings, including the dozen or fifteen great buildings of the University proper, and the twenty-five or thirty houses of the professors residing on the grounds. The main buildings are principally at the north extremity of the campus, and the technical departments are housed at the extreme north, on the edge of the Fall Creek gorge, from which are derived water-supply and water-power. Here a great brown-stone building, Lincoln Hall, is appropriated to the College of Civil Engineering and its allied School of Architecture. The three main buildings, Morrill, McGraw, and White Halls, are opposite, forming the main front of the University, toward the city of Ithaca lying in the beautiful valley, at the head of the lake four hundred feet below, and less than a mile away. The great library building given by Mr. Sage to the University as a memorial to Jennie McGraw Fiske, "whose purpose shall not fail," terminates this grand line of great edifices. It will be one of the most convenient, as well as largest and most beautiful, buildings for the purpose yet built in any land. Its capacity is for nearly half a million volumes, with ready extension to a million. Between $15,000 and $18,000 will be annually appropriated for additions to the catalogue, and it is expected that it will not only comprise the best of general literature, but will offer the grandest facilities for technical study to be found outside the Patent Office library, if not even superior, in time, to that.

The principal changes of the year have been the completion of a very large chemical laboratory (with accommodations for what have been of late years the largest entering and undergraduate classes in the United States, introductory laboratories, lecture-rooms, analytical laboratories, assay-rooms, and special laboratories for advanced work, both in instruction and research); the reconstruction and re-arrangement of the physical laboratories, now filling the great brown-stone building called Franklin Hall; and the extensions of Sibley College. We hope at some future time to be able to give full descriptions of these special laboratories, and will now only remark that they are working the largest classes in their several departments ever yet collected in engineering courses, and probably better illustrate what can be done by system and skill in administration, with crowded classes, than any thing else in the University. We must confine ourselves at the moment to the last of this series of changes.

The outline-plans seen in the illustrations represent the working parts of the College of Mechanical Engineering and the Mechanic Arts as now arranged for a maximum of six hundred students; the number working during the last year being about four hundred, of whom a very considerable number were graduates of the academic courses of this and other universities, or of technical courses in this and other colleges and technical schools, and including a number of professors of distinction engaged in departments of mechanical engineering elsewhere, who were engaged in the study and practice of laboratory methods as applied in engineering.

The main building, Fig. 1, is shown in heavier line than the shops and laboratories which are adjacent. The work in chemistry and in physics is given in the great laboratories of the University, as is all work in pure mathematics and in languages, thus leaving the professional work only to be done in the Colleges of Engineering. The ground-floor sketch shows the main building, 165 feet by 45, with its museums, library, and reading-room, in

which the working library is kept and all its technical periodicals — a hundred of them — filed. In the court is the boiler-house with its 600 horse-power of water-tube boilers, selected for safety and compactness; at the left, the dynamo-room with its driving engines; beyond, the machine-shop, 165 feet by 40, and its office, toilet-rooms, and lockers (of the latter some 500, including those at the foundry and forge across the road). The latter building is 150 feet by 40, and, though a frame building, one of the neatest buildings on the campus. Between this building and the main building of Sibley College, and east of the latter, is the large building, 150 by 40, devoted to the work of the Department of Experimental Engineering,—the mechanical laboratory,—in which

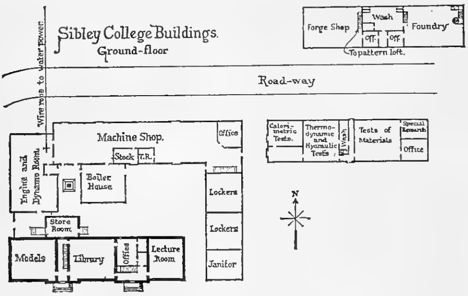

FIG. 1.

are placed all the testing-machines for metal and materials of all sorts, from 10,000 to 100,000 pounds capacity; a number of lubricant testing-machines; and also a considerable amount of miscellaneous apparatus of research in engineering. The boiler-test department is fitted up in the main boiler-house; and the several engines are placed adjacent, both the half-dozen devoted to experimental use and those employed for driving the dynamos used for electric lighting. The plans of the second floor, Fig. 2, exhibit the extent of the wood-working shops, 165 by 40; the upper part of the laboratory building, in which the problems of design and of the laboratory are worked out; and the arrangement of the main building; in the latter the offices and lecture-room of the

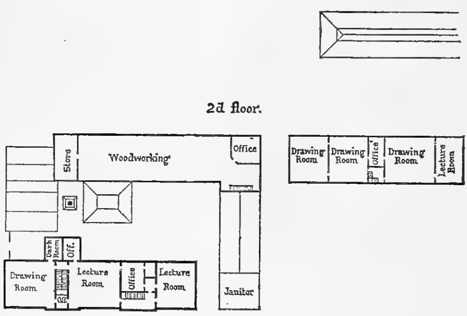

FIG. 2.

director, and the lecture-room of the professor of electrical engineering. The professor of mechanic arts, the professor of machine construction, and the professor of experimental engineering share the other lecture-rooms shown in this and the other plans; while the officer detailed from the United States Naval Engineer Corps to give instruction especially in steam and naval engineering finds accommodations in the laboratory building.

These plans are not, however, precisely accurate in their apportionment of apparatus. The Department of Electrical Engineering and that of physics have become so large, and their stock of apparatus so extensive, that it is probable that the coming college year may see all their larger machinery transferred to the dynamo-room, and even overflow into the west end of the machine-shop floor, which is, however, only a provisional arrangement of the professors of physics and of electrical engineering, and subject to amendment as the exigencies of the case may require. The crowd of small dynamos for individual instruction, of which there are a half-dozen each, for example, of the Edison and the Westinghouse, and a number of others of the better known types, will be used in the physical building. Other dynamos and other engines are continually coming in, and it is thought to be but a matter of very short time before it will be found imperatively necessary to put up a great engineering laboratory, in which to group every thing demanding power and steady speed, as well as all the apparatus of the Sibley College proper. It is presumed that, when built, it will bear the name of the "coming unknown," who will thus at once do a great work and build himself a permanent monument.

Space will not permit the description of the improved and numerous courses of instruction open to technical students at Cornell to-day. They include purely professional courses in agriculture and in engineering, courses in chemistry and physics, in all the natural sciences, and in mathematics, pure and applied, and undergraduate and advanced, in every line in which the ambitious student may desire to excel. For those entering the professions, the courses in patent law and in political and social economy, in ethics and in history, are well adapted, and are found fittingly to supplement the work in the engineering and other technical courses. Many students are taking advanced work in technical departments, and at the same time such outside work as their plans may seem best to warrant. All students in regular mechanical engineering are given instruction in electricity; and, for those who desire it, work is specialized, in the senior and post-graduate years, for students in electrical engineering, as in steam, marine, and other lines of engineering, and in professional work having relation thereto. Of all this, the interested student may learn by applying to the President of the University; to the Director of Sibley College, and to the heads of the other great departments, in either of which he may desire to work.

THE TIME-RELATIONS OF MENTAL PHENOMENA.

[Continued from p. 117.]

HAVING thus considered the time-relations of a simple re-action, we may proceed, on the line of analysis there laid down, to the consideration of the more complex forms of re-action.

Adaptive Re-actions.

It has been noted that the prominent characteristic of a useful re-action is the adaptation of the response to the excitation by which it was called out. This adaptation involves a recognition of the stimulus, and its association with the movement in question. In this recognition we found it convenient to distinguish between the recognition of the presence and that of the nature of the stimulus; but it may be questioned whether we can recognize the presence except by noting some point of the nature of the stimulus, and whether the noting of this point does not involve its distinction from others. If, in re-acting to a sound, I recognize that it is the stimulus to which I am to re-act, and press the key, does this mean that I know that the stimulus is not a visual or a tactile one, that it is not a higher or a lower, a louder or a feebler, sound? Here, as still more in the analysis to follow, our experimental basis is defective. Experiment has naturally followed the lines of convenience and ready analysis; and as there has been little harmony in these analyses, and as the one here adopted differs somewhat from those adopted by other writers, it will be difficult to maintain the parallelism between theoretical

discussion and the obtained results. If we understand by the simple re-action the mere signalling that a definite, predesignated, and expected stimulus is present, and by an "adaptive" re-action one in which the mode of response depends upon and varies with the nature of the stimulus, we may distinguish the following stages of connection between the two:—

I. *A single stimulus with a single mode of re-action.* II. *Several stimuli with a single mode of re-action.* (a) The subject *foreknows* the stimulus. (b) The subject *does not foreknow* the stimulus. III. *A single stimulus with several modes of re-action.* IV. *Several stimuli with several modes of re-action.* (a) The subject foreknows the *stimulus and* also the *re-action.* (b) The subject foreknows the *re-action*, but *not* the *stimulus*	SIMPLE RE-ACTIONS.
(c) The subject foreknows *neither stimulus nor re-action.*	ADAPTIVE RE-ACTION.

Or, more simply, if the re-action is foreknown, the process is a simple re-action; if not, it is an adaptive re-action. In addition, in the simple re-action the foreknowledge of the stimulus may be entirely definite, the stimulus always being the same, or there may be a known range of variation or an unknown range of variation; while in the adaptive re-action the possibilities are limited to the latter two.

I. has been fully considered. In II. (*a*) we have a number of different simple re-actions; but, instead of investigating them in separate series, we have different kinds in one series: e.g., a sound, a light, or a touch may appear, it being announced to the subject which it is to be; and he in each case re-acts by pressing the key. The impressions may be more homogeneous, as a series of colors; but in all cases the subject need not appreciate the nature of the stimulus, but simply that a stimulus has appeared. In II. (*b*) the subject knows the possible stimuli, but does not know which is to come next; otherwise the conditions are precisely the same as above. Wundt's experiment with the irregular change between two intensities of sound would belong here, and would indicate that this is an essential factor. In III. the several modes of re-action are necessarily known in advance. Instead of testing the different forms of re-actions in separate series, we have several in one series. For example: we re-act to a sound now with the thumb, then with the forefinger, the subject always knowing in advance what he is to do. In IV. (*a*) we are combining into one series different forms of simple re-actions, differing both in stimulus and form of re-action; but the complete re-action (e.g., red color to be re-acted to by middle finger) is announced beforehand. In IV. (*b*) the subject is told in advance how to re-act, but not what the stimulus is to be. However, in both this and the foregoing case he need not wait to recognize the nature of the stimulus, but re-acts as soon as he detects its presence. All these are variations of simple re-action times. When we pass to IV. (*c*), we have a different, namely, an *adaptive*, re-action. The subject is not told any thing in advance except the association upon which he is to re-act: e.g., if a blue light, with the right hand; if a red light, with the left hand; and so on. The essential difference here is that the subject must first distinguish a certain feature of the nature of the stimulus, in this case the color; then call up the appropriate movement and perform it. A re-action of this kind, therefore, involves a definite distinction of stimuli, and a choice of movements.

Distinction and Choice.

The mental processes involved in an adaptive re-action, in addition to those involved in the simple re-action, are thus a more specific recognition of the stimulus, and a choice between movements. By maintaining all other factors alike, the difference of time of the two modes of re-action measures the combined time of distinction and choice. The first determinations of this nature were made by Donders and his pupils (1865–68). A simple re-action to a light, white or red, was made in 201σ (average of five observers);[1] but an adaptive re-action with the right hand for the one light, and the left hand for the other, in 355σ,—a difference of 154σ. Cattell makes a simple adaptive re-action to two colors in 340σ, his simple re-action time being 146σ, or a difference of 194σ (XI.). Münsterberg re-acts simply with any of the five fingers in 141σ, but re-acts with a definite finger (according as the numbers of the fingers "one," "two," "three," etc., are called) in 195σ longer (XXIV.). Accepting these as values for the combined distinction and choice time under simple conditions, our next step would naturally be to determine how much of the time is due to distinction, how much to choice. This is a difficult step; for we cannot readily determine that a distinction has been made, except by indicating it in the mode of re-action, and we cannot execute a choice except upon the basis of some distinction. The most usual experiment by which it has been attempted to overcome this difficulty consists in re-acting to only a designated one of a group of stimuli, allowing all others to pass without re-action. To take a simple case, let red and blue be the possible stimuli: if red appears, re-act; if blue, do nothing. While this form of experiment is interesting and useful, the inferences from it are not as clear as could be wished. It may be termed the "incomplete adaptive re-action," or briefly the "incomplete re-action." It involves a distinction of the stimulus to be re-acted to, from those not to be re-acted to, and a choice between motion and refraining from action. It seems probable that these processes are respectively easier than a distinction that cannot be anticipated and a choice between two movements; but it seems equally probable that the extent of these differences will vary considerably under different circumstances. If the simple re-action is of the quick, motor form, and the incomplete re-action involves an additional distinction of the stimulus, as well as the choice between motion and rest, the additional time above the simple re-action would be long, and the difference between it and the adaptive re-action short. This is evidently the case with Cattell and Berger, who, with a simple re action of 146σ and 150σ, perform the incomplete re-action in 306σ and 277σ, the adaptive in 340σ and 295σ (IV. and XI.). On the other hand, Donders, with an evidently sensory mode of re-action, has a simple re-action of 201σ, an incomplete of 237σ, and an adaptive of 284σ. A second method attempts to deal with the difficulty by delaying the re-action until the precise nature of the stimulus has been appreciated, and regards the difference in time between this and the simple re-action as the time needed for the distinction of the stimulus. There is nothing but the subjective guaranty that the moment of re-action is coincident with the process of recognition, and we have no reason to regard this guaranty as valid. There may be a tendency

[1] The sign σ indicates one one-thousandth of a second.

to make the distinction on the basis of the after-image, and thus signal the appreciation of it too soon; or, again, an extreme desire not to re-act before the distinction is made may delay re-action to an unusual length. Friederich's investigations show for colors a simple re-action time of 175σ, and a "subjective distinction" time of 267σ (XXXIX.); the methods for comparative purposes; and, in addition, we can vary the complexity of the distinction while leaving the choice the same (and to a more limited extent can vary the choice without the distinction), and thus can in many cases distinguish whether an increased complexity of an adaptive re-action is to be referred to an increase in the difficulty of

Table of Complex Re-action Times.[1]

No.	Nature of Distinction Between.	Character of Experiment.	Nature of Re-action.	Observer.	TIME.	Simple Re-action Time.	No. of Possible Impressions.	Remarks.
I	Black and white-on-black ..	Incomplete.	Finger.	Cattell.	241	146	2	Re-act to white-on-black.
II	White and a particular color.	"	"	"	249	146	2	Re-act to color, varied amongst ten.
III	White and a color............	"	"	"	264	146	2	Re-act to color, but need not distinguish same.
IV	Red:blue or green:yellow....	"	"	"	306	146	2	Re-act to predesignated color
V	Colors.......	"	"	"	313	146	10	" " " "
VI	Roman capital letters........	"	"	"	326	146	26	" " " letter
VII	Short English words..........	"	"	"	360	146	26	" " " word (printed).
VIII	Long " "	"	"	"	375	146	26	" " " " "
IX	Short German "	"	"	"	367	146	26	" " " " "
X	Pictures of objects..	"	"	"	309	146	26	" " " picture.
XI	Red:blue or green:yellow....	Adaptive.	Right & left hand.	"	340	146	2	
XII	Pairs of short English words.	"	Naming.	"	401	170	2	5 sets. Average of re-actions to all.
XIII	" " colors.............. ..	"	"	"	438	170	2	" " "
XIV	" " pictures..............	"	"	"	437	170	2	" " "
XV	Capital Roman letters..... ..	"	"	"	424	170	26	
XVI	" German letters.......	"	"	"	526	170	26	
XVII	Short English words..........	"	"	"	409	170	26	
XVIII	" German "	"	"	"	439	170	26	
XIX	Colors........................	"	"	"	601	170	10	
XX	Pictures of objects...........	"	"	"	545	170	26	
XXI	Words in construction........	Continuous series.	"	"	138	170	Indefinite.	English.
XXII	" "	"	"	"	250	170	"	German.
XXIII	" "	"	"	"	288	170	"	English, read backward (right to left).
XXIV	Spoken words, "one," "two," "three," "four," "five"....	Adaptive.	5 fingers.	Münsterberg.	383	162	5	Sensory.
XXV	" words, "lupus," "lupi," "lupo," "lupum," "lupe"	"	"	"	465	162	5	"
XXVI	Spoken words, 3 groups of 5 grammatical forms.	"	"	"	688	162	5	" Ich meiner mir mich wir. Du deiner dir dich ihr. Der des dem den die.
XXVII	" words, 5 categories...	"	"	"	712	162	5	" *Noun, pronoun, adjective, number, verb.*
XXVIII	" " " ..	"	"	"	893	162	5	" *City, river, animal, plant, element.*
XXIX	" " " ..	"	"	"	1122	162	5	" *Author, musician, naturalist, philosopher, statesman.*
XXX	Direction of light............	Incomplete.	Finger.	Kries: Auerbach.	209	195	2	Whether right or left spark goes first.
XXXI	Colors........................	"	"	"	227	209	2	
XXXII	Distance of points	"	"	"	2 3	177	2	Whether in front or in back of fixation-point.
XXXIII	Localize touch................	"	"	"	161	132	2	On middle finger or back of hand.
XXXIV	Tones of different pitch	"	"	"	177	143	2	Re-act to higher.
XXXV	Tone and noise...............	"	"	"	176	142	2	
XXXVI	Strong and weak touch.......	"	"	"	176	134	2	" " strong.
XXXVII	Tones of different pitch......	"	"	"	202	158	2	" " lower.
XXXVIII	Strong and weak touch.......	"	"	"	219	140	2	" " weak.
XXXIX	White and black.............	Subjected.	"	Friederich's 3 subjects.	267	175	2	
XL	White, black, red, green.....	"	"	"	296	175	4	
XLI	One-place numbers	"	"	"	318	186	9	Read.
XLII	Three-place "	"	"	"	397	186	900	"
XLIII	Five-place "	"	"	"	697	186	Indefinite.	"
XLIV	Sounds of different intensity	"	"	Tischer's 6 subjects.	146	114	2	
XLV	" " "	"	"	"	164	114	3	
XLVI	" " "	"	"	"	178	114	4	
XLVII	" " "	"	"	"	194	114	5	
XLVIII	Visual impressions...........	Adaptive.	2-10 fingers	Merkel's 10 subjects.	276	188	2	Any two of the numbers 1, 2, 3, 4, 5, and I., II., III., IV., V.
XLIX	" "	"	"	"	394	188	4	" four of the Nos. 1, 2, etc.
L	" "	"	"	"	489	188	6	" six " " "
LI	" "	"	"	"	562	188	8	" eight " " "
LII	" "	"	"	"	588	188	10	The ten numbers "
LIII	100 words.....................	Continuous.	Naming.	Cattell.	255	—	—	
LIV	100 letters	"	"	"	224	—	—	

[1] Roman numerals in the text refer to the corresponding experiments in this table.

while Tigerstedt, and also Tischer, find only about half this difference for nearly the same re-action. It seems wisest, under these circumstances, not to decide the relative shares of the distinction and choice in the adaptive re-action, but to study the combined time as a whole, and the influences by which it is affected. We can thus utilize the results of all the choice or to an increase in the difficulty of the distinction.

It is desirable to analyze more particularly the nature of the difference between the simple re-action and the "subjective," and between the simple and the incomplete. An essential point relates to the mode of re-action, whether motor

or sensory; nor is it necessary that the same mode of re-action be followed in all cases. The possibilities thus are (1) that both the simple and the subjective times will be sensory; (2) both motor; or (3) the simple sensory, and the other motor; or (4) the simple motor, and the other sensory. (1) This seems to be the mode best suited to the subjective method. It supposes the processes to take place serially, and the simple time not to involve the recognition of the specific nature of the impression. (2, 3) If the subjective distinction is made on the motor plan, it can only mean that the re-action takes place too soon, and that the distinction is really made after the movement has been made. In this case the distinction time would be too small. (3) probably does not occur. (4) is apt to occur, and would yield a very long distinction time. That these considerations are practically important can be illustrated by Tischer's results upon nine subjects with sound re-actions and distinctions. The average of the nine gives a distinction time of 159σ, and a simple time of 118σ. Four of the subjects evidently make use of the motor re-action, their simple time being 107σ, and their subjective distinction 116σ; i.e., they anticipate the distinction. Berger and Cattell express the same difficulty, and for this reason discarded the method. Their simple re-action to weak light was 198σ, with distinction of intensity 208σ. Two of the subjects evidently re-act according to the sensory method, their simple re-action being 141σ, and the subjective distinction 246σ. That these are not individual differences is shown by the fact that the adaptive re-actions are about alike in all. Similarly with regard to the difference between the simple and the incomplete re-action times. If both are sensory in character, we might expect that the incomplete would be longer by the addition of an easy distinction and choice, and this seems to be only a slight addition. Donders, and those of Tischer's subjects who re-act by the sensory method, show a relatively small difference, though this is not true of Friederich's subjects. While Tischer's "motor" subjects show a difference of 159σ between the simple and the incomplete, the "sensory" subjects show one of only 61σ. (2, 3) If the incomplete re-action is motor in form, the difference between it and the simple re-action will be very small; more so in (3) than in (2), though (3) is not likely to be used. The expectation is entirely directed to the stimulus upon which re-action is to follow, and the fact that other stimuli may appear hardly enters into the experiment. Under this head it seems fair to classify the results of Kries and Auerbach, who, with clearly motor re-actions, find a difference of 30–40σ for (XXX.–XXXVI.) a variety of incomplete re-actions. (4) It is much more likely that the change from the simple to the incomplete form of re-action will bring with it an attention to the sensory part of the process, and thus make the difference between it and the simple time long. This seems to be the case with Berger and Cattell, who, with a simple re-action time of 147σ and 150σ, have an incomplete re-action time of 306σ and 277σ. The difference between the incomplete and the adaptive re-action seems to be uniformly small (many of the differences being not far from 40σ), though the individual variations are considerable. It is likely that the effects attributed to practice and fatigue may really be due to a change from the sensory to the motor form of re-action. Thus Kries and Auerbach mention that their incomplete times were at first very long, but that they became very small, the reduction continuing long after the effect of practice upon the simple re-action had ceased. Again, the fact that simple re-action times are long when following complex ones, or that subjective times are longer when following adaptive re-actions, seems to be not so much the effect of fatigue as of a continuance of a sensory mode of re-action. It should also be mentioned that Tigerstedt ingeniously proposes to measure the distinction time by taking the difference between two incomplete re-actions, in one of which we re-act to a definite simple impression, and in the other to the impression requiring distinction (e.g., in one series I re-act to white, but not to a color; in the other, to a color, but not to white); and the difference in time will be needed for distinguishing a color from white. The general fact remains, then, that while the combined distinction and choice times exhibit only such individual and other variations as seem explicable by the differences in the conditions of experiment (the adaptive re-action times of eight of Tischer's nine subjects fall between 293 and 320σ), the estimates that have been attempted of the portions of the time due to distinction and to choice separately, show such large variations as to force the conviction that the different experimenters were not measuring the same processes.

Conditions Affecting Distinction and Choice.

Bearing in mind that we are dealing with comparative results only, — comparisons restricted mainly to the results of the same observer, obtained by the same method, — we proceed to investigate the conditions by which these processes involving distinction and choice are affected. It will be convenient to begin with the effect of (1) *the number of distinctions and of choices.* The effect of the number of objects among which distinction is to take place, upon the time needed to make the distinction, is best shown in the "incomplete" and subjective methods, in which the range of distinction may be varied without affecting that of choice. For example: Cattell makes an incomplete re-action to a certain color when either that or one other color may appear in 306σ, when either that or any one of nine other colors may appear (IV. and V.) in 313σ. Friederich's subjects make a subjective distinction between two colors in 267σ, between four in 296σ (XXXIX. and XL.). Six of Tischer's subjects make a subjective distinction between two sounds of different intensity in 146σ (simple re-action, 114σ); between three sounds, in 164σ; four sounds, in 178σ; five sounds, in 194σ (XLIV. and XLVII.). Other experiments cited in the table show the same slight increase of distinction time with the increase of the range of impressions, but complicated with other factors as well. With regard to the effect upon the choice time when the number of possible choices increases, we have the results of Merkel, who found for the simple re-action time of ten subjects to visual impressions 188σ; for an adaptive re-action between two impressions, 276σ; between three, 330σ; between four, 394σ; between five, 445σ; between six, 489σ; between seven, 526σ; between eight, 562σ; between nine, 581σ; and between ten, 588σ (partially cited in XLVIII.–LII.). The impressions were the numbers 1, 2, 3, 4, 5, and I., II., III., IV., and V. The re-actions to movements of the ten fingers naturally associated with these impressions, and the naturalness of this association doubtlessly contributes to the small increase in time. Münsterberg *called* these numbers and re-acted in the same way, finding for a choice between five movements 383σ, and between ten 478σ (simple re-action being 162σ). It being established that but a small share of the increase is due to the distinction (Merkel has experimentally shown this for his subjects), we may conclude, that, with an increase in number, the difficulty of choice increases more rapidly than the difficulty of distinction. In addition, we have reason to believe that the increase would be still more marked in case the association between impression and motion is artificial. When this association reaches the maximum of naturalness, in naming objects, the increase with the number of impressions is slight. Thus it may be calculated from Cattell's results that it takes him but about 10σ longer to name 26 letters or short words than to name

one of two, but 60σ longer to name one of 26 than one of two pictures, and 163σ longer to name one of ten than one of two colors; the action of naming being more closely related to letters and words than to pictures and colors.

It is the ability to deal promptly and correctly with a large and varying number of impressions, disposing of each in its appropriate way, that we recognize as evidence of mental power, and it is this that experiment shows to be a factor of great influence upon the time of an adaptive re-action. It is the skill in disposing of so large a number of adaptive re-actions that we admire in the post-office clerk, and in many other exhibitions of manual dexterity. It is this that necessitates the division of labor, there being a limit to the number of adaptive re-actions that can be economically controlled. Again: the fact that a large number of distinctions does not complicate the process as much as a large number of choices, finds its analogue in the observation that our power of reproduction falls below our powers of appreciation. This plays a part in the fact that we learn to understand a language long before we learn to speak it, and in many similar processes. The development of mental power reveals itself as an increasing facility in performing a large number of complicated adaptive re-actions; and here, too, the power of appreciating distinctions develops earlier than the power of choosing. This result was illustrated experimentally in a brief study of the re-action times of a ten-year-old child as compared with those of an adult. While the pure distinction time rose from 58σ to 250σ as the impressions to be distinguished increased from two to five (subjective method, with colors), as compared with 44σ and 78σ for adults, for the adaptive re-action for two impressions the time was 120σ, for five impressions 603σ, as compared with 79σ and 210σ for adults.

We may conveniently introduce the general topic of the effect of the nature of the distinction and the choice upon the time of its performance with the consideration of a few points affecting the distinction alone. (2) *The similarity of the impressions.* The endowment of the various sense-organs varies considerably (e.g., the sense of musical pitch is finer than that of sound intensity); but, in the absence of a standard of comparison of sense-differences in disparate types of sensation, we can only illustrate the point in question by varying the difficulty of distinction within the same sense. Thus Kries and Auerbach find that it takes much longer to tell whether a sound is to the right or to the left, according as the two points at which the sound is produced are closer together when they form an angle of 35°–120° with the centre of the face. The additional time (by the incomplete method) was 17σ; when varied between 35° and 26°, the time was 78σ; when within 26° and 11°, it was 137σ. The ease of distinction is largely a function of practice. We readily seize the slight optical differences furnished by the different letters of a known language, but constantly confuse much greater sense-differences with which we are less familiar. (3) *The specific nature of the impression.* Very many of the results cited in the table may be said to illustrate the effect of a change in the nature of the distinction; but it is difficult to show this, uncomplicated with other variations. The determinations of Kries and Auerbach (XXX.–XXXVIII.) show the result of distinctions of various kinds, though an analysis of the causes of these differences is hardly practicable. It is quite clear that in re-acting by the incomplete method the re-action is shorter when the stimulus is the stronger of two intensities than when it is the weaker of the two (XXXVI. and XXXVIII.). Berger has also shown that the intensity of the stimulus has some influence upon the distinction time beyond what would be due to the effect upon the simple re-action time therein contained. The difference between the corresponding simple and the incomplete re-action to a bright light is 85σ; to a medium light, 119σ; to a weak light, 114σ; while similar differences for adaptive re-actions are 167σ, 179σ, 192σ; the inference being that the intensity of the stimulus affects the distinction rather than the choice. Again (in the series VI.–X.), we find that Cattell recognized most quickly that an expected one of 26 pictures was present, then that one of 26 letters, next one of 26 short English words, next one of 26 short German words. The differences between the time for recognizing letters and short words is very slight compared to the increase in complexity of the impression, and thus shows the effect of practice in recognizing words as a whole. Furthermore, in the series of experiments (partly cited in XLI.–XLIII.) in which one to six place numbers were recognized, while there is a concomitant increase in the number of possible impressions, it seems fair to refer the main increase in time to the increasing complexity of the impression. In passing from the recognition of one to two or of two to three place numbers, the increase in time is slight; but from there on, the increase itself increases with the increase of the number of numerals (53σ, 147σ, 322σ),—a fact probably related to the practice in grasping numbers in groups of threes. Another series (XXIV.–XXIX.) may be mentioned here, and is interesting as indicating that it is more difficult to tell to which of five categories (*a city*, *a river*, etc.) a word belongs than what part of speech it is; and this is in turn easier than to tell the sphere of activity of a noted man. It should be noted that the choice, the range of impressions, the connection between impression and movement, the method of re-action, are equivalent in all three experiments; so that the difference is fairly referable to the distinction process involved. We may finally notice as here pertinent the observations of Vintschgau upon the distinguishability of different tastes. He found that by the incomplete method it took longest to re-act to bitter when the alternative was distilled water, next long to sweet, next to sour, and shortest to salt. Similarly, in adaptive re-actions with the two hands to all possible combinations of two of the four tastes, salt was most quickly re-acted (384σ), sour next (397σ), sweet next (409σ), and bitter last (456σ).

(4) *The Foreknowledge of the Subject.* Within the restriction that the foreknowledge of the subject shall be limited to the knowledge of the associative bond between stimulus and movement, there is room for variation. The simplest case would present but one stimulus re-acted to, and but one not re-acted to, or, in the adaptive re-action, but one stimulus for each mode of re-action. In all such cases (I., II., IV., XI., XXXVIII., may be cited as instances) the foreknowledge of the subject presents the maximum of definiteness. Any departure from these conditions brings with it an increase in the time of re-action. Cattell finds but a very slight increase (5–7σ) in the incomplete re-action when the stimulus *not re-acted to*, instead of being but a

single one, is any one of ten colors, but finds a greater increase (15σ, difference of II. and III.) when the stimulus *re-acted to*, instead of being a single one, is one of ten colors, though the particular kind of color need not be recognized. Both the stimulus re-acted to and the one not re-acted to might be one of a larger or smaller, a more or less homogeneous group; but I am unable to find a record of such an experiment. The somewhat modified form of experiment adopted by Tigerstedt and Bergrist shows a similar result. They re-acted to a light, when either the light or a one to three place number might appear, in 297σ, and to the number (including its recognition) in 318σ. If the number of digits of the numbers that may appear is foreknown, the time is considerably reduced; and when either the light or a foreknown letter might appear, the time for recognizing the light was still further shortened (190σ). The same series of variations could be applied to adaptive re-actions (i.e., one or more, or all, of the modes of re-action might be associated with any member of a variable group of stimuli), but experiments designed to show the effect of such variations are lacking. Mention should be made, however, of the experiments of Münsterberg, in which he first re-acts with the five fingers to five categories, each limited to one term (XXIV. and XXV.); then to five categories, each comprising three terms (XXVI.); and then to five categories, each comprising a practically indefinite number of terms (XXVII., XXVIII., XXIX.); and finds an increase of time in making these steps, not only in the sensory mode of re-action (as cited in the table), but in the motor as well (as will be noticed below). Although other factors contribute to this increase in time, part of it may be referred to the decreasing definiteness of the foreknowledge of the subject. It may be added, that the mechanism by which an increase in the number of possible re-actions increases the re-action time is allied to that by which a decrease in the foreknowledge of the subject does so.

[Continued on p. 148.]

NOTES AND NEWS.

A PROCESS of manufacture of filtering material is described by the *Engineering and Mining Journal* as consisting essentially in reducing ferric oxide by heating it in contact with gaseous fuel. Small pieces of iron ore, preferably hematite, are packed into a retort heated externally, preferably by producer gas. When the charge is at a cherry-red heat, gaseous fuel is admitted into the retort and brought into thorough contact with the ore. At the end of four or five hours, if the exit gas be inflammable, the process is finished, and the charge raked out and allowed to cool. Ordinary coal-gas or other gaseous fuel may be used instead of producer gas. The magnetic oxide so produced is available for filtering water, sewage, sugar sirups, alcoholic liquors, etc.

— The fourth annual session of the Iowa Academy of Sciences was held Sept. 4 and 5, at Des Moines, Io., in the High School Building, Science Rooms, corner of Fifteenth and Centre Streets. The following is a list of the papers read: "The Gall-Producing Cynipidæ of Iowa," by C. P. Gillette; "Evolution of Strophostylus," by Charles R. Keyes; "Two Quaternary Sections near Des Moines," by R. Ellsworth Call; "Abnormal Pelage in Lepus Sylvaticus," and "Additions to Catalogue of Iowa Hemiptera," by Herbert Osborn; "Further Notes on the Geology of North-western Iowa," and "Exhibition of Volcanic Ashes from Omaha, Neb.," by J. E. Todd; "Varieties and Structure of Oolite," by E. H. Barbour; "The Woody Plants of Western Wisconsin, a Contribution to the Local Flora of La Crosse, Wis.," by L. H. Pammel; "On a Quaternary Section Eight Miles South-east of Des Moines," by R. Ellsworth Call and Charles R. Keyes; annual address, by President F. M. Witter, Muscatine; "A New Cecidomid Infesting Box-Elder," by C. P. Gillette; "Age of the Iowa City Sandstones," and "Notes on the Red Rock Sandstone," by Charles R. Keyes; "Preliminary Notes on Fishes of Polk County and Central Iowa (exhibition of specimens), by R. Ellsworth Call; "Notes on the Life-Histories of Certain Hemiptera," by Herbert Osborn; "The Shore-Lines of Ancient Glacial Lakes," by J. E. Todd; "Some Parasitic Diseases of Iowa Forage-Plants," by L. H. Pammel; "Fishes of the Cedar River Basin," by Seth E. Meek; and "Report of the Committee on Iowa Fauna," by C. C. Nutting (chairman). The following are the officers for 1890: president, F. M. Witter, Muscatine; first vice-president, C. C. Nutting, Iowa City; second vice-president, C. P. Gillette, Ames; secretary and treasurer, R. Ellsworth Call, Des Moines; executive council, the officers, and Professors J. E. Todd (Tabor), Herbert Osborn (Ames), and L. H. Pammel (Ames).

— "Little Giant" Edwin Checkley, who has just broken the long-distance bicycle record between New York and Chicago, making the distance in a little over fourteen days, undertook the task without any previous special training, pursuant to the theories set forth in his book, "A Natural Method of Physical Training," which has been creating so much talk among athletes and members of the medical profession. Mr. Checkley opposes modern athleticism as practised in and out of the colleges, and argues that his own extraordinary strength and agility are to a great extent possible even to persons of comparatively sedentary habits, if a certain simple course is followed. Checkley, who was educated as an engineer, and is now studying medicine, is five feet five inches in height, and weighs only one hundred and twenty-five pounds; but he can lift two men, each weighing two hundred pounds, and trot with them for one hundred yards.

— The American Bankers' Association have devoted much time lately to a consideration of the question, "What can be done to prepare for their future careers those youths who expect to follow banking as a business?" In the course of their investigation, their attention was attracted by the work of the Wharton School of Finance and Economy,—a department of the University of Pennsylvania which has, among other courses, one in banking. Professor Edmund J. James, one of the senior professors in the school, who has devoted much time and thought to educational questions, was invited to deliver an address upon the school and its work before the convention at Saratoga, which met from the 3d to the 6th of September. The address, which was delivered on the evening of the 3d of September, includes, besides an account of the Wharton School of Finance and Economy, a discussion of the general subject of what our colleges are doing for the education of our business-men. It is pointed out that Mr. Carnegie, in his famous interview on the subject, was practically correct when he said that the colleges, speaking generally, are not educating the business-men of the community. A smaller and smaller proportion of the youth of the country are going to college. This is true even of those who expect to become lawyers and physicians, and still truer of the immensely greater number who expect to take up business careers. This fact is also emphasized by Professor Shaler of Harvard, in an article on the subject in the August *Atlantic*. Professor James takes the ground that this is very natural, considering the curriculum of our colleges. It is, however, very unfortunate. The higher education of our business classes is absolutely essential to our permanent welfare. Whether for good or ill, the control of our modern life, the school, society, politics,—the church, in a word, of our civilization itself,—is slipping into the hands of our business classes. The professional world is losing, the business world gaining. It is no longer the great lawyer, statesman, or clergyman, but the great banker, manufacturer, railroad manager, who speaks the decisive word in many matters of public importance. The higher education of these classes is therefore of fundamental importance to our social and political existence. The problem is to be solved by the addition to our existing college curricula of courses which have a direct relation to the wants of educated business-men in some such way as existing courses correspond to the wants of the future teacher, or engineer, or architect.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

THE TIME-RELATIONS OF MENTAL PHENOMENA.

[Continued from p. 147.]

The effect of the *mode of re-action* upon the re-action time is the same here as in the simple re-action. Re-acting by the voice in the incomplete form of re-action has been found to be longer than re-acting by the finger; and whenever the re-action takes the form of speaking or naming, it takes some time to place the organs in position and speak the word. But a very special and important effect in adaptive re-actions is that of (5) *the association between movement and stimulus.*

As the effect of a special or a general practice, certain modes of re-acting to certain types of stimuli have become natural, easy, and familiar, while in other cases (e.g., the re-acting by pressing a key, — a process learned only for the purposes of the experiment) the association is extremely artificial. If we compare, in Münsterberg's series, the experiment in which the five fingers re-act to the numbers "one," "two," "three," "four," "five" (XXIV.), with that in which they re-act to the declensional forms of a Latin noun (XXV.), we recognize that the former is a more natural association than the latter, and seem justified in attributing a good share of the increase in time to this difference. Again: to re-act by naming is a process in which we have had considerable training, and it is quite evident that the time needed for naming one of 26 different impressions (XV.–XVIII., and XX.) is much shorter than would be needed for re acting by 26 artificial and irregular movements of the hand. The difficulty in learning a foreign language, or a telegraphic code, or a shorthand system of writing, is largely the difficulty of forming associations between complex stimuli and movements; and the great decrease in time that is brought about when such associations have been mastered emphasizes the importance of the factor now under discussion, which, in turn, may be regarded as an expression of the effect of practice.

We may push the analysis a step farther. The process of naming is much more closely associated with a word or a letter than with a picture or a color; for the former are artificial symbols, merely becoming significant only when so interpreted, while the latter reveal their meaning directly without needing to be named or read. Accordingly, we find that it takes longer to name a color (601σ) or a picture (545σ) than to name a letter (424σ) or a word (409σ), though the recognition of a color or a picture is a quicker process than the recognition of a letter or a word (compare XV., XVII., XIX., XX., and V., VI., VII., X). Furthermore, if the time of naming or reading is thus mainly conditioned by the strength of association involved, we may in turn utilize this process as an index of familiarity with the naming or reading, or, more briefly, with the language. Thus Cattell, an American, reads English words more quickly than German (XVII. and XVIII.), while with Berger, a German, this relation is reversed. To name a picture in German occupies Cattell for 614σ; in English, 588σ. It occupies Berger in German for 501σ; in English, 580σ. The inference is the same (though the absolute time is much shorter) if we read words in construction instead of isolated. By this method Cattell finds that he can read an English word in 138σ, a French in 167σ, a German in 250σ, an Italian in 327σ, a Latin in 434σ, and a Greek word in 484σ, this being the order of his familiarity with these languages. The particular nature of the association may be revealed in the study of these time-relations. Thus, while in all cases it takes longer to read words from right to left than from left to right, this difference is relatively least in the least familiar languages; i.e., in those in which the bond of association between the words is least significant. For a like reason letters are read much more quickly from above downwards (102σ) than from below upwards (264σ).

(6) *The Overlapping of Mental Processes.* We pass now to a point of critical importance in the application of results gained in the laboratory, to the mental operations of daily life. While in the former case we are performing a set task in isolation for purposes of investigation, in the latter case (i.e., in such operations as reading, copying, playing upon instruments, and the like) we are performing a continuous, more or less extended, series of re-actions, bound together by bonds of common purpose and associations of habit. It is not a mere aggregate, but an organization of mental processes; and this makes possible the performance of the several factors of the process in part at the same time. It leads to an "overlapping" of the mental elements. It is a

proficiency in thus doing several things at once that constitutes much of the difference between the expert and the novice; and it is this "telescoping" process that seems to be the method by which complicated operations are at length performed in short times. It is for this reason that the time per word of reading 100 words is shorter than the time of reading a single word. Cattell reads a short word in 409σ, a long one in 451σ, but 100 such in 255σ per word, and, if the words are in construction, in 125σ per word; thus indicating how much of the difference between ordinary reading, and reading single words, is due to the continuity of the experiment, how much to the association between the words. So, also, Cattell reads a single letter in 424σ, but 100 such in 224σ (compare XVII., XV., with LIII., LIV.). When the series is too long continued, fatigue sets in, and the time is again longer; it is longer for 500 than for 100 words and letters; and for colors and pictures there is no saving in naming 100 above naming a single color or picture.

A special study of this power of grasping several things at once was made by Cattell by having letters move along on the surface of a rotating drum, and varying the width of a slit in a screen through which they were read. When the slit just allowed one letter to be seen at a time, they could be read at the rate of one letter in 228σ; and as the slit was widened to admit two, three, four, five, and six letters at once, the rate increased to one letter in 200σ, 178σ, 166σ, 160σ, and 160σ. As it takes 424σ to name a letter singly (XV.), it would seem that the whole of a letter need not be seen at once to be recognized,—an inference corroborated by the fact, that, when the slit admits only one-tenth of a letter at a time, the letters can be read at 400σ per letter. The result also indicates that there is a limit to the power in question. M. Paulhan finds similar results in more complex operations. He multiplies numbers and recites a verse or two at the same time; and the time needed for this is shorter than the sum of the times required to do each separately. In very simple cases the time of doing both together is not longer than the time for doing the more difficult of the two separately. The mind should accordingly not be likened to a point at which but a single object can impinge at one time, but rather to a surface of variable extension. It should likewise be noted that the performance of a complex and extended mental task is not the same thing as the separate performance of the several elements into which that task may be analyzed.

The distinction between the *sensory* and *motor* form of re-action requires mention in this connection, because, when applied to complicated adaptive re-actions, it seems to involve overlapping of mental processes. The times cited in the table (XXIV.–XXIX.) in Münsterberg's experiments (and they are the only ones available for the present purpose) refer to sensory re-actions. In these the attention is directed to the word about to be uttered. It is recognized, and referred to its group. The corresponding movement is then aroused and performed, the several processes being successive in time. In the motor form the word is thought of as a "forefinger-moving" word; and the movement upon which the attention is kept fixed is expectantly kept ready to be set off at the slightest notice. The several processes thus play into one another, some perhaps entirely falling away. Both anticipatory movements and errors (moving the finger next to the correct one) are not infrequent. The motor times for the series XXIV.–XXIX. are 289, 355, 430, 432, 432, and 437σ; the differences between motor and sensory times, 94, 110, 258, 280, 461, 685σ. Until these very important and striking results are better understood, it would be unwise to enter into a discussion of them; but it may be noted (*a*) that the increase in the complexity of the processes is more regular and prominent in the "sensory" times, the "motor" times of the last four experiments of the series being about alike; (*b*) that the "motor" complexity seems to be related to the range of the impressions; and (*c*) that the differences in time between the two modes of re-actions increase as the processes become more complex.

(7) *Practice and Fatigue.* What was said under these headings of simple re-actions applies with equal force to complex ones. Various experimenters notice the decrease in time as the experiments proceed. They note that this decrease is relatively greatest at first, and in those individuals and processes whose time is relatively longest at the outset; also that it soon reaches a limit, and, when once thoroughly acquired, is not liable to be lost after a moderate degree of disuse; and that it at times seems to be confused with a transition from a sensory to a motor form of re-action. As illustrative of one or other of these points, it may be mentioned that Tischer finds as a rather typical case the decrease of a distinction time from 160σ in the first set to 95σ in the second, and 86σ in the third, all reduction ceasing on the average after 5.5 sets; that Trautscholdt, in re-actions consisting of repeating a word, finds times of 299, 273, and 258, and in another case of 205, 176, and 155σ, in three successive periods of fourteen days each; that for Berger and Cattell, beginning with some practice in experiments of this kind, find the time for incomplete re-actions reduced by 30 and 20σ after four months' experimentation; and, finally, that the great decrease in the incomplete re-actions of Kries and Auerbach (from 64 and 117 to 21σ, from 153 and 109 to 36σ, from 104 and 97 to 49 and 54σ, in various experiments) strongly suggests a radical change in the mode of re-action. Another aspect of the effect of practice appears in a study by Berger of the times required by the boys of the nine classes of a German Gymnasium, and of the class preparatory to the Gymnasium, to read 100 and 500 words in construction in German and in Latin at a maximum and at a normal rate. There is a constant decrease in time as the boys advance in age. In Latin the several times per word were 262, 135, 100, 84, 79, 57, 54, 49, 48, 43σ; in German 72, 55, 43, 37, 39, 28, 27, 26, 25, 23σ; the great difference between the first two times in Latin being due to the fact that the boys who required 262σ to read a Latin word had never learned Latin at all. That these differences are to be referred to specific practice rather than to general mental maturity, appears from a comparison of the above times with the times required by those boys to name colors; viz., 135, 99, 119, 123, 100, 91, 112, 99, 86σ.

The results regarding fatigue are not equally definite. Many mention the general fact of fatigue, and to avoid it perform but few experiments in a series. We have already seen that it takes relatively longer to read 500 letters, words, colors, pictures, than to read 100. On the other hand, Cattell, after a very long series of re-actions, found no serious or constant increase in the time, but seemed to feel the ef-

fects of fatigue on the following day. Both practice and fatigue are subject to large individual variations. Oehrn has studied the minor variations of practice and fatigue in a session of two hours' work, finding first a stage in which practice outweighs fatigue, and then a stage in which the reverse is true.

(8) *Miscellaneous and Individual Variations.* The complex re-actions, just as the simple ones are subject to the influences of distraction, vary under the action of drugs, in morbid conditions, and present large individual variations. These points, though frequently noticed incidentally, have not been subjected to special study, so that briefly citable and conclusive figures are lacking. Regarding the action of drugs, Kraepelin is inclined to believe that the distinction is, under their influence, almost always rendered more difficult, being only slightly subject to the period of shortened times, while the choice factor very readily becomes shorter than the normal. Marie Walitzkaja finds that the complex re-action times in the insane differ more from the normal than do their simple times. An adaptive re-action for the two hands which for the normal required 351–406σ, required 707–943σ in cases of general paralysis, and 1,085σ in a case of mania. These should, however, be regarded as individual rather than general results. The individual variations may be regarded as increasing with the complexity of the re-action. Men differ more from one another in the time needed for doing difficult things than in the time needed for simple things. Systematic experimentation upon this point is lacking: but a suggestion of the truth may be obtained by calculating the average deviation from their mean, of Merkel's ten subjects in their simple re-action times, their subjective distinction times, and their adaptive re-action times; the result being 2.23 per cent, 3.35 per cent, and 6.79 per cent. JOSEPH JASTROW.

[To be continued.]

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

A Study of California Soils.

THE material greatness of California rests, in the last analysis, upon the vast range and high native fertility of its soils. California is a State with but few deposits of coal and iron, though possessing almost every other kind of mineral. Its food-producing resources, as shown by the character and extent of its soils, are very much beyond any thing that the Californians themselves have ever claimed.

The longest report on California soils that has ever appeared is that in the "Tenth Census Report;" but the work of soil-analysis has been going on ever since, and the larger number of the State University's agricultural bulletins are devoted to this and cognate subjects. The agricultural subdivisions adopted are as follows: the Sacramento valley; the San Joaquin valley; the Sierra foothills; the southern or Los Angeles region; the coast region north of San Francisco and San Pablo Bays; the coast region south of those bays.

In all of these districts the variety of soils is very great. Only a few especially representative soils can be tabulated at length in this article. The Sacramento valley, for instance, contains a great variety of rich sediment soils, gray or dun-colored, powdery loam, very rich and easy of tillage; also dark adobe loams, moderately heavy, paler in color a foot below the surface; also clay loams, brown-black when wet; also heavy, black adobes, the strongest of wheat-lands; also light, grayish-yellow "slickens," the mining *débris* deposit. All these soils have a sufficient and often a very generous supply of lime. In all the alluvial soils the amount of potash is large, sometimes very large. The supply of phosphates is not large. Professor Hilgard sums up the Sacramento valley lands by saying that the predominant soils are "fine-grained alluvial loams, with extensive belts of heavy clay," or, in the California phrase, "adobe lands." The California adobe is much like the black prairie soil of the Mississippi, but the phosphoric-acid supply is one-third higher.

Sacramento Valley Soils.

	River Alluvium.	Black Loam Soil.	Valley Soil.	Mining Sediment.
Insoluble matter, and silica	73.444	62.304	71.005	69.062
Potash	.652	.305	.929	.300
Soda	.077	.221	.124	.124
Lime	1.444	2.909	.770	.521
Magnesia	2.277	1.042	2.285	.768
Br. oxide of manganese	.015	.025	.106	.089
Peroxide of iron	5.804	9.342	8.011	6 586
Sulphuric acid	.030	.068	.120	.067
Alumina	10.397	13 038	9.159	14.229
Phosphoric acid.	.087	.095	.111	.078
Water and organic matter	5.351	10 149	7.115	8.024
Total	99.578	99.498	99.735	99.848

In the great San Joaquin valley the prevailing character of the soil is sandy, often very coarse. There are also black adobes in narrow belts, near the rivers or sloughs, and hillocky plateau lands, either loamy or of gravelly clay, with much hard-pan. The "red soil" of the foot-hills shows many distinct sorts. Orange-red is nearly the prevailing tint. Red loam, red gravel, red clay, and the red soil of the placer mines, filled with decomposed slate, are among the kinds of Sierra foot-hills soils. The color comes from the presence of four to twelve per cent of iron oxide. The average of phosphates is low, but in some districts the supply is all that can be desired. These soils are eminently well adapted to vines, fruit-trees, and vegetables. In the Coast

San Joaquin Valley Soils.

	Black Adobe.	Brown Adobe.	Dry Bog Land.	Wire-Grass Land.
Insoluble matter and soluble silica	72.058	79.492	67.34	71.420
Potash	.396	.714	1.05	1.224
Soda	.479	.444	.84	3.043
Lime	1.927	1.769	6.51	3.043
Magnesia	1.640	2.048	3.96	.087
Br. oxide of manganese	.056	.041	.04	.030
Peroxide of iron	6.815	3.728	5.05	5.823
Alumina	11.620	7.988	7.97	7.137
Phosphoric acid	.179	.038	.32	.239
Sulphuric acid	.037	.074	.08	.655
Carbonic acid	—	—	4.42	2.546
Water and organic matter	5.871	3.244	3.71	7.091
Total	101.078	99.580	101.29	99.972

Range there seems to be all possible varieties and combinations of soils.

The nature of California soils can better be shown by taking some representative soils in the various districts, and giving the complete analysis from several different localities.

Bench Lands and Sierra Foot-hills.

	Fresno Plains.	Red Loam.	Red Foot-hills.	Red Chaparral.
Insoluble matter, and silica	88.579	82.592	69.52	68.861
Potash	.340	.249	.38	.417
Soda	.248	.035	.07	.052
Lime	1.163	1.021	.96	.288
Magnesia	.499	.471	1.09	.207
Br. oxide of manganese	.034	.018	.39	.087
Peroxide of iron	3.267	5.811	12.42	7.705
Alumina	3.221	6 283	10 97	14.443
Phosphoric acid	.097	.043	.16	.047
Sulphuric acid	.117	.019	.01	.074
Water and organic matter	1.789	3.644	5.14	7.680
Total	99.368	100.186	101.11	99.815

The famous bed-rock land, long considered worthless, lies on the borders of the valley. The soluble silica runs to six and eight per cent; alumina, above five per cent. There are only small quantities of potash, soda, and magnesia, but the sub-soil in a measure supplies these deficiencies. Lime is in adequate quantity. This is the soil where giant-powder is used to break up the bed-rock when planting orchards, and the trees afterwards thrive.

The dry bog soil is immensely rich, equal in native qualities to the famous buckshot soils of the Yazoo bottoms, but the surplus of alkaline salts prevents its use until reclaimed by fresh water or gypsum. The wire-grass soil is highly productive. There is a little alkali, but not enough to injure it. The brown adobe is a very representative soil, deep reddish brown in color, contains much sand, and is easily tilled.

Southern California Soils.

	Mojave Desert.	San Gabriel Valley.	Mesa Land.	Silty Soil. Lower Bench.
Insoluble matter and soluble silica	75 964	81.12	86.21	87.511
Potash	.928	.27	.48	.634
Soda	.078	.17	.14	.070
Lime	1.787	.68	.36	.759
Magnesia	1.782	1.77	.54	.593
Br. oxide of manganese	.026	.10	.01	.025
Peroxide of iron	5.478	6.30	3.69	3.350
Alumina	9.227	6.79	5.12	3 095
Phosphoric acid	.056	.16	.23	.200
Sulphuric acid	.012	.07	.03	.003
Carbonic acid	.456	—	—	—
Water and organic matter	3.903	3.07	2.60	3.132
Total	99.697	100.50	99.50	99.372

The foot-hill region ranges in width from ten to fifteen miles. The soils show very considerable differences, but the greater portion are of a "fair to high quality." There is a "mountain adobe" of the high valleys, which in some cases runs very high in magnesia, alumina, and ferric oxide. The "mining slum" is of exceedingly varying quality, some of it worthless for a long time; in other sections, a fair garden soil almost immediately. A large percentage of lime is present in many cases in the mining *débris*, or sediment.

The soils of the southern region—south of Tehachipi—are perhaps as varied as in any part of California. The great Mojave Desert is one of the important features. Here extensive tracts only lack water to make them of much cultural value. In fact, this high plain has ample lime and potash, though little humus, and hardly enough phosphoric acid. The arable lands of southern California consist of "bottoms," bench lands, mesas or high bench lands, mountain soils, and seacoast soils. The coast valleys are strong in phosphates; the mountain lands have more lime and humus. Reddish gravelly soils, excellent for fruit, are a characteristic feature.

There is a silty soil in many places, which retains its tilth so well that a man can easily thrust an axe-handle down to the head in the light-umber soil.

The Coast Range, like southern California, has so wide a range of sorts that a hundred analyses would not be sufficient to exhaust the number of typical cases. Many of the light soils show an especial power for absorbing moisture, and a high percentage of humus. Phosphates will probably be the first things to be exhausted. As a rule, they are adapted to fruits rather than to grains. There are black adobe soil, redwood bottom, yellow and brick-red mountain soils, gravels, loams, and almost every possible variety and combination. CHARLES HOWARD SHINN.

Niles, Cal., Sept. 3.

BOOK-REVIEWS.

An American Geological Railway Guide. By JAMES MACFARLANE. 2d ed., revised and enlarged. New York, Appleton. 8°.

FROM a geologic point of view, this is a model handbook for tourists. The names of the railway stations are arranged as in an ordinary time-table, with the distances in miles from the beginning of the line; but, instead of the times of running trains, the traveller is informed of the age of the bed-rocks and the height of each station in feet above the sea. Abundant footnotes also call attention to localities of special interest to the collector of fossils and minerals, or to quarries, mines, oil or gas wells, remarkable waterfalls, gorges, or mountain views.

Dr. Macfarlane is well known by his earlier work, "The Coal Regions of America." Since his death in 1885, his son has bestowed much care and effort, during the scanty leisure allowed by professional duties, to the completion of this new edition of the "Railway Guide." In this work he has been aided by many geologists, both of this country and Canada, who have contributed the portions relating to the regions covered by their field-work. Among these names we note Broadhead, J. L. and H. D. Campbell, Chamberlin, Chance, Chester, Collett, Condon, Cooper, Crosby, Dana, Darton, Davis, G. M. Dawson, Dwight, Emmons, Fontaine, Gannett, Gesner, Gilbert, Hague, Hall, Hilgard, Hitchcock, Hunt, Irving, Johnson, Kerr, Lesley, Loughridge, McGee, Newberry, Orton, Owen, Procter, Pumpelly, W. B. Rogers, Russell, Safford, Shaler, Smith, Smock, Stevenson, St. John, Todd, Uhler, Upham, White, Whitfield, G. H. Williams, Willis, A. and N. H. Winchell, Worthen, Wright. The book is prefaced by tables of the geologic formations and their descriptions, occupying about fifty pages, "intended for railway travellers who are not versed in geology."

A Stem Dictionary of the English Language. By JOHN KENNEDY. New York, Barnes (Amer. Book Co.). 8°.

THE author of this work believes that children in learning to read should trace words back to the stem from which they are derived, but that in so doing they should not go out of the bounds of their own language. Thus, he holds that *bene-* in the word *benefit* should be treated as the stem of the word, without regard to its previous history in Latin. With this view he has prepared this dictionary, giving the most important stems derived from Latin and other tongues, with the principal words in which they occur and their definitions, and also the foreign words from which they are derived. Stems of Saxon origin are not usually given,

as the student is presumed to be sufficiently familiar with them and their meaning. How useful the book may prove can only be determined by experience; but many pupils will be interested in thus tracing the various derivatives of a given stem. There is one serious defect in the execution of the work. The pages are encumbered with long notes, sometimes filling half a page, about such things as the atmosphere, gravity, gladiatorial shows, etc.,—notes which are sadly out of place in a dictionary. We noticed also some inaccuracies, such as calling the Latin *honestus* Greek, and the Greek *laos* Latin. The work is illustrated by numerous quotations, mostly in verse.

An Elementary History of the United States. By CHARLES MORRIS. Philadelphia, Lippincott. 12°. 60 cents.

THIS work covers the whole period of American history from the discovery of the continent to the present time; and yet it is all crowded into two hundred and forty pages. The natural result is that the narrative is too much condensed, and contains too much detail for so short a work. This is the common fault of brief histories, and not only renders them less interesting than they might be, but also tends to obscure the main outlines of the subject. Apart from this defect, however, Mr. Morris's work is pretty well done. We like in particular the attention he gives to the social life of the people and the progress of industry,—matters that are not only important in themselves, but also interesting to young people. The book is illustrated with both pictures and maps.

AMONG THE PUBLISHERS.

THE September issue of the *Contemporary Review* will contain an article covering some twenty-three pages, by Rudyard Kipling, entitled "The Enlightenment of Pagett, M.P.," which, in the form of a story, is a trenchant criticism on the National Congress movement in India. The *Contemporary* is published in America by the Leonard Scott Publication Company at 40 cents per number.

—Messrs. Houghton, Mifflin, & Co. announce that they will have ready for publication in the early part of September a book by John Fiske, entitled "Civil Government in the United States, considered with some Reference to its Origins." In this book Mr. Fiske aims to set forth the principles and methods of civil government as understood and exemplified in the republic of the United States and in the several States; and he traces the rise and development of the various forms of government of towns, counties, cities, states, and the nation, with their relations to one another. Although of great interest to the general reader, the book is designed primarily for use in schools; and to make it still more practicable for this purpose, there have been added at the end of each section questions on the text, and at the end of each chapter suggestive questions and directions "designed to stimulate reading, investigation, and thought." These questions and suggestions have been prepared with great care by Frank A. Hill, the head master of the English High School at Cambridge, Mass. Mr. Fiske has also added a bibliographical note at the end of each chapter.

—The most important article in the *Political Science Quarterly* for September is that on "State Control of Corporations," by George K. Holmes. It is an account of what has been done in Massachusetts toward securing the rights of the public against corporations of every description, and is a very encouraging exhibit. The Massachusetts method consists in the maintenance of commissions whose duty it is to hear complaints, settle disputes when possible, and give advice to the Legislature on the one hand, and to the corporations on the other. This method has proved very successful in protecting the public against abuses; and, in Mr. Holmes's opinion, it only needs to be extended to trade com-

Publications received at Editor's Office,
Aug. 25—Sept. 6.

DIEHL, Mrs. Anna Randall. A Practical Delsarte Primer. Syracuse, N.Y., C. W. Bardeen. 66 p. 16°.
HAYWARD, R. B. The Elements of Solid Geometry. London and New York, Macmillan. 130 p. 16°. 75 cents.
HEALTH for Little Folks. New York, Cincinnati, and Chicago, Amer. Book Co. 121 p. 12°.
KENNEDY, J. A Stem Dictionary of the English Language. New York, Amer. Book Co. 282 p. 8°.
MILNE, J. J., and DAVIS, R. F. Geometrical Conics. Part I. The Parabola. London and New York, Macmillan. 72 p. 12°. 60 cents.
MORRIS, C. An Elementary History of the United States. Philadelphia, Lippincott. 250 p. 12°. 60 cents.
ORPHEUS, The. Vol. I. No. 1. Aug. 15, 1890. St. Paul, Minn., Orpheus Publ. Co. 16 p. f°. $1 per year.
PRESTON, T. The Theory of Light. London and New York, Macmillan. 465 p. 8°. $3.25.
THRUSTON, G. P. The Antiquities of Tennessee and the Adjacent States. Cincinnati, Robert Clarke & Co. 369 p. 8°. $4.
U. S. DEPARTMENT OF AGRICULTURE. Report on the Substitution of Metal for Wood in Railroad Ties, by E. E. R. Tratman, C.E., together with a Discussion on Practicable Economies in the Use of Wood for Railway Purposes, by B. E. Fernow. Washington, Government. 363 p. 8°.

binations to be a complete success. Another interesting paper in the *Quarterly* is a sketch of "German Historical Jurisprudence," by Ernst Freund, giving a clear though brief account of the rise and progress of juristic studies in Germany. Mr. Fred. Perry Powers, in a paper on "Recent Centralizing Tendencies in the Supreme Court," contends that the Court has gone too far in claiming for Congress power over interstate commerce. Professor Seligman continues his series of articles on "The Taxation of Corporations;" Professor Ashley has a somewhat elaborate review of Charles Booth's work on "East London;" and there is also an article by William Chauncy Langdon on "Italy and the Vatican," which is mainly devoted to setting forth the views and policy of the late Baron Ricasoli. On the whole, this number of the *Quarterly* is a good one; and yet we feel bound to say that there is very little in it that can properly be termed scientific. The majority of the articles are on questions of practical politics, and only one or two of them deal with really scientific problems.

—The Forest and Stream Publishing Company (New York) announce for immediate issue "House and Pet Dogs; their Selection, Care, and Training." It is written by a woman. The same firm will publish at once "The Spaniel and its Training."

— The Putnams have published "The Pleroma, a Poem of the Christ," by Rev. E. P. Chittenden, consisting of two parts. The first part is an imaginary account of the creation of the world, which is performed by the "Pleroma," or fulness of the Godhead, while the "Circles," the "Bands," the "Limits," and other fanciful beings, look on and sing. The days of creation are made to represent the successive geologic ages, the scenery of which is illustrated by numerous pictures. The second book treats of "Christ in History," beginning with the Garden of Eden. The author expresses the hope that his book will "find favor among Christian students of science and scientific students of Christianity;" but why it should do so we are unable to see, for it is neither poetical nor scientific, and is wholly devoid of moral significance. You may read pages of it without finding an idea; and the book is not in any sense an addition to literature.

— Jules Verne's latest story of travel and adventure, "Cæsar Cascabel," will be published early in the fall by the Cassell Publishing Company, who have made an arrangement with the author to that end.

—Messrs. Ginn & Co. announce to be ready this month "A Hygienic Physiology," for the use of grammar and common schools, by B. F. Lincoln, M.D., late secretary of the Medical Department of the American Social Science Association, author of "School and Industrial Hygiene," etc. The chief object of this book is to present the laws of health as fully as pupils fourteen or fifteen years old can be expected to understand, appreciate, and apply them. The distinctive feature of the work is thus its putting hygiene first, and making anatomy and physiology tributary, instead of making anatomy and physiology the main things, and introducing hygiene incidentally. Enough of the theoretical is in all cases given to supply a basis for the practical; but it is given with a varying fulness, according to the nature of the topic under consideration. Thus, under the head of "Bones," the anatomy and physiology take up most of the chapter, while the anatomy of the digestive organs is treated but briefly, the chief attention being directed to food, ways of cooking and eating, etc. Exercise, sleep, bathing, ventilation, and kindred subjects are carefully treated. Alcoholic beverages have a chapter to themselves; but additional remarks, if they seem called for, are given at the end of the chapters on other subjects. It has been the writer's endeavor to present this matter wisely and truthfully, and it is believed that his views are in harmony with the opinions of the recognized leaders of modern medicine, and avoid the dangers of distrust and re-action which attend over-statement.

THE *Medical Press*, July 30, 1890, says that on July 26 a girl nineteen years old died at Plaisance, near Paris. This girl was of an enormous size. A year ago she was weighed, and was found to exceed 470 pounds, and since then she had considerably increased. Around her waist she measured two yards and a half, while the circumference of her arm exceeded one yard. She succumbed to erysipelas.

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THE TIME-RELATIONS OF MENTAL PHENOMENA.

[Continued from p. 150.]

Association Times.

WHILE the effect of the association between stimulus and movement upon the time of the re-action has been already discussed, the process of association forms so important a factor in our mental life, that it requires a more specialized and independent investigation.

(1) *Questions with but a Single Answer*. We may view an adaptive re-action under the aspect of a "question and answer;" the stimulus being equivalent to the question, "What, with regard to certain points, is this impression?" and the answer, whether indicated by a name, or word, or movement, is given in the re-action. Our problem is to investigate the time-relations of these questions and answers, as an index of the readiness of the association between the two. The processes intervening between the appreciation of the question and the formulation of the answer may vary greatly in complexity and character. A common characteristic of the re-actions hitherto regarded consisted in the fact that the material for forming the answer is simply and directly supplied by the stimulus itself: it is in the main a verdict regarding the particular nature of sensation then present. The re-actions to which we now pass all include something more than this; and the formulation of the answer involves to a greater or less extent more complicated forms of mental activity, and depends more or less upon the past experiences, the special habits and tendencies of mind, of the individual.

While the line of division between the direct appreciation and the indirect interpretation of a sense-impression cannot be rigidly drawn, and while it is no less difficult to decide what processes are involved in this interpretation and elaboration of the sense-impression, yet we may with sufficient precision mark out as the first class of associations (a) those in which *a simple act of memory* plays the chief *rôle*. Thus, when Cattell, instead of naming a picture in his own language (which he does in 545σ), names it in German (in 694σ), the difference in time is needed for calling to mind the German name, and measures the strength of this association. Berger's acquaintance with English is less than Cattell's with German, and accordingly with him the difference between naming a picture in the vernacular and in a foreign language is greater (477σ and 649σ). The translation of a short familiar word from English to German occupies Cattell 686σ; from German to English, but 580σ; the time for long and less familiar words being much longer (we may obtain the portion of the time required for the act of translation alone by subtracting from this the time to see and name a word, 428σ). Such operations as addition and multiplication, when confined to numbers of one place, can hardly be more than acts of memory. Cattell adds such numbers in 336σ; Berger, who is a mathematician, in 221σ. The former multiplies them in 544σ; the latter, in 389σ. Vintschgau's three subjects multiply such numbers (though under different conditions) in 233σ. More complicated types of "memory re-actions" have been performed by Cattell and by Münsterberg. The former determined in separate series the time necessary, when given a city, to name the country in which it was situated (462σ); when given a month, to name the season to which it belongs (310σ), to name the following month (389σ), to name the preceding month (832σ); given an author, to name the language in which he wrote (350σ); given an eminent man, to name his sphere of activity (368σ). Münsterberg constantly varied the type of question including such as the above, the position of cities, the qualities of objects, the relations of men, and many others, finding an average time of 848σ (average of two subjects). While many of these determinations are doubtless of more individual than general value, we may stop to note a few points that are presumably typical. The re-actions here grouped under one class vary considerably in difficulty, and a few instances may be cited to indicate the range of this variation. In giving a country in which a given city is situated, the shortest time is for Paris (278σ); the longest, for Geneva (485σ). In giving the language in which an author wrote, Berger requires least time for Luther (227σ) and Goethe (265σ), most for Bacon (565σ); Cattell, least for Plato (224σ) and Shakspeare (258σ), most for Plautus (478σ). In giving the calling of an eminent man, the least time is required for poets (291σ), the longest for men of science (421σ). Münsterberg mentions as quickly answered questions (400σ to 600σ), "On what river is Cologne?" "In what season is June?" "In what continent is India?" as questions requiring a long time (1100σ–1300σ), "Who is the author of Hamlet?" "What is the color of ice?" "Who was the teacher of Plato?" An influence which we have found of great significance hitherto is equally important here; viz., the foreknowledge of the subject of what is to occur. In Cattell's experiments the general question is virtually asked once for the entire series, the special terms being given in each experiment, while in Münsterberg's results the entire question changes with each observation; and this difference in the expectancy of the subject cannot but be an important factor in the longer times found by the latter. A

somewhat different phase of this influence appears in the results of Vintschgau. In multiplying the numbers from 1×1 to 9×9, the smaller number was always announced first. Accordingly, when the first nine was announced, the subject practically anticipated the result, and had the product ready; when eight was announced, he knew that it was one of two results; when seven, one of three; and so on. Accordingly we find these to be the shortest processes (9×9, only 160σ); but there is another factor at work counteracting this effect, viz., the familiarity of certain multiplications, making the products by *one* short, and those by four and five long.

(*b*) The next type of "question and answer" will be one in which, in addition to the act of memory, a *comparison*, or a *judgment*, is involved. The result of the comparison, though not always the same for all individuals (and in this sense the question is not limited to a single answer), will probably always be the same in the same individual. The only experiment of Cattell's that seems properly to belong here is that in which the subject decided which was the greater of two eminent men (558σ). Münsterberg finds the average time for answering a miscellaneous group of such comparisons 947σ, or 99σ longer than the process without comparison: comparisons rapidly made (600σ–800σ) being, "Which has the more agreeable odor,—cloves or violets?" "Who is greater,—Virgil or Ovid?" "What is more beautiful,—woods or mountain?" and difficult questions (1200σ–1500σ) being, "Which is healthier,—swimming or dancing?" "Which do you like better,—Goethe's drama or his lyric?" "Which is more difficult,—physics or chemistry?" The comparison may be among more than two objects. Thus, in asking which is the finest of Goethe's dramas, the process of formulating the reply may include the calling to mind what the various dramas are, and a choice among them; not, of course, a considerate judgment, but the selection, under the necessity of an immediate answer, of one deciding motive. On the other hand, among the several possibilities, a certain one may, by habitual association or for other reasons, have become so prominent that virtually no comparison ensues; and the relatively slight excess in time of this type of association above the former ones (1049σ) suggests that this was often the case. To decide which is the pleasantest odor (rose), or which the most important German river (Rhine), required only between 600σ and 700σ; to decide which was the most difficult Greek author (Pindar), or your favorite French writer (Corneille), from 1400σ to 1600σ.

Münsterberg has ingeniously modified this form of experiment to show the influence of the foreknowledge or preparedness of the subject. He precedes the asking of the question by a dozen or so words of the category within which the comparison is to be made. Thus, "Apples, pears, cherries, peaches, plums, grapes, strawberries, dates, figs, raisins: which do you like better,—grapes or cherries?" Although the comparison cannot be begun until the last word is heard, still the subject has in a way anticipated the general nature of the question, as well as the scope of the comparison, and has reduced the time considerably (676σ, as compared with 947σ),—certainly a striking result.

(2) *Questions with More than a Single Answer.* In the class of re-actions to which we now pass, the question admits of several answers. The answer at one time may and need not be the same as at another time; and the determining factors in the particular character of the answer are the peculiar mental habits and tendencies of the individual. The question thus changes from a specific to a general one, the answer being any member of a more or less extended class answering to such and such a description. In some the choice may be somewhat limited. This is true of Cattell's experiments in which, given a country, we are to name a city in it (346σ); given a season, to name a month in it (435σ); given a language, to name an author writing in that language (519σ); or, given an author, to name any work of his (763σ). In all these cases we are apt to have in mind only a very few prominent instances under each head among which individual preference is exercised. In the following series the classes are more general, and accordingly the scope for individual preference much larger: given a general term to name a particular instance under that term (537σ); given a picture to name some detail of it (447σ); given the word instead of the picture, to make a similar association (439σ); given the picture or the name to mention some property of it (372σ and 337σ); given a quality to name an object to which it can be applied (351σ); given an intransitive verb to find an appropriate subject (527σ), or a transitive verb to find an appropriate object (379σ). Münsterberg has a series including a miscellaneous collection of such re-actions, and finds a time of 1036σ. Trautscholdt has investigated a similar series in which a specific instance of a general term had to be given, and finds a time of 1020σ (average of three subjects), 155σ of which must be deducted to get the pure association time.

Here, again, we may stop to consider a few generalizations which these results seem to sustain. The processes involved vary very considerably in the different experiments. Münsterberg cites as quick responses (450σ–600σ) the instancing of "a German wine (Rüdesheimer)," "of a number between ten and four (six)," "of a Greek poet (Homer);" as slow ones (1200σ–1500σ), "a beast of the desert (lion)," "a French author (Voltaire)." Trautscholdt names "mast" as "a part of a ship" in 391σ, but requires 1899σ to name "art" as "an æsthetic activity of man." These differences should appear in the average variations; that is, the average divergence of the re-action times from their mean. When the process is simple and constant, the average variation is small; when the processes are complicated and variable, the average variation is large. While in simple re-actions it is often less than 10 per cent of the re-action time, it is not infrequently as high as 30 per cent in the re-actions just considered. It may have been noticed that in certain cases the process in (2) was the reverse of that in (1). The one was a step from the whole to the part, the general to the special; while the other was from the part to the whole, the special to the general. In Cattell's case the former is the longer (433σ and 374σ). In Trautscholdt's results the conclusion comes out more clearly, the pure association time of an association of part to whole is 608σ; of whole to part, 901σ; of special to general, 754σ; of general to special, 947σ. It is thus easier to refer an individual object or quality to its class than to give an instance of a general concept. A similar result (namely, that the bond of association between two concepts is not equally strong in both directions) is derived from observing that it takes longer to recall that May precedes June than

that June follows May, longer to go back and find a subject for a verb than to go forward and find an object for it, longer when given a quality to find an object possessing that quality than to recall a quality for an object, and so on.

We may here also conveniently consider the overlapping of mental processes, which we have found takes place whenever a series of simple processes, or a complex process involving many simple ones, is performed. The general truth that the time of a complex mental operation is less than the sum of the times needed for the performance of the separate factors into which the former may be resolved, will be again illustrated Thus Münsterberg finds that it takes 103σ to name a specific instance of a class (e.g., to name a German river), 992σ to make a comparison, (e.g., Which is more important, — this river or that?) but only 1049σ to decide both questions together (e.g., Which is the most important German river?) In this case we clearly recognize that the last processes are not the sum of the preceding two, but that the category "most important German river" is already formed in the mind. The following comparisons are more illustrative. Instead of asking first, "Which is the most important German river?" (1049σ,) and then, "Which lies more westerly, — Berlin, or the most important German river?" (992σ,) we ask at once, "Which lies more westerly,— Berlin, or the most important German river?" and find the time 1855σ, or 176σ less than the sum of the two foregoing processes. Similarly, if instead of asking first, "On what river is Cologne situated?" (848σ,) and then, "Which is more westerly, — the Rhine or Berlin?" (992σ,) we ask at once, "Which is more westerly, — Berlin, or the river on which Cologne is situated?" we find a more remarkable saving of time (1314σ, or 526σ less than the sum of the two questions). This time was still further reduced to 1149σ when the question was preceded by a list of a dozen cities.

(3) *Unlimited Associations.* When we pass to the re-action of naming as rapidly as possible any word whatever, that is suggested by a given word, we are drawing entirely upon the natural associative habits of the individual, and accordingly this method has been most useful in studying psychological habits and tendencies. Our present purpose, however, is only with the time-relations of this unrestricted association. This has been the type of association first and most frequently investigated, and it is customary to speak of the pure association time as the total time minus the time needed to repeat a word. Thus Münsterberg repeats a word in 382σ, and calls out a word in association with the given word in 896σ. Trautscholdt, however, who experimented upon Wundt, Stanley Hall, and two other subjects, finds an average time of 1024σ, 727σ of which is regarded as the pure association time. Galton and others have made estimates, by rougher methods, of the rapidity with which trains of ideas pass through the mind, and the result is a rate not differing much in either direction from one association per second. It will be recognized at once that this process will be very different in different individuals and with different words. Münsterberg's shortest association was "gold–silver" (390σ); the longest, "sing–dance," "mountain–level" (1100σ–1400σ). Trautscholdt also found "gold–silver" a very quick re-action (402σ), "storm–wind" (368σ), "duty–right" (415σ). Long re-actions were "God–fearing" (1132σ), "throne–king" (1437σ), "Karl–August" (1662σ). Some interesting inferences result from the consideration of the times of different types of these unrestricted associations. Trautscholdt divides these into "word associations," or those suggested by the word rather than by the thing; "outer associations," or those relating to the sense-qualities of the object; and "inner" or logical associations. The results were 1033σ, 1028σ, 989σ, though this order may be liable to individual differences. Cattell and Berger have also compared the re-action times to concrete nouns (374σ, pure association time), to less concrete nouns (462σ), to abstract nouns (570σ), and to verbs (501σ), clearly showing that concrete terms are more readily suggestive than abstractions, and concrete objects more so than actions. Trautscholdt finds for associations to concrete nouns, 710σ; to actions, 837σ; to abstractions, 871σ.

Many of the influences to which we found simpler forms of re-action times open, are doubtless true of association times, but the great variability of the latter makes these difficult to establish. The effect of practice is noticed by Trautscholdt; and Cattell has shown that in students from thirteen to eighteen years of age a distinct shortening of the association time accompanies growth and education, while the students ranking higher in class have a somewhat shorter time than those standing low in class. Fatigue very readily enters, the accessible associations are easily exhausted, and the mind repeats itself very markedly. Changes under the action of drugs and in morbid mental states have been incidentally noticed, but still await systematic investigation.

The various processes, the times of which we have been studying, by no means exhaust the possibilities in this field. As our knowledge of mental operations becomes more perfect and more capable of experimental study, and as our power of analysis makes similar progress, the study of the time-relations of mental phenomena, already fertile in suggestions and results, will increase in interest and importance.

JOSEPH JASTROW.

MODERN EXPLOSIVES AND FLUID FUELS.[1]

SIR FREDERICK ABEL commenced with a reference to the great names in art and science which Leeds could claim as its own. He next proceeded to refer to the advances made in electrical science and its application to industrial purposes; dealing with the history of the subject since the association last met in Leeds, in 1858, and bringing it to the present day by a reference to the scheme now on foot for utilizing the power of the Falls of Niagara, electric welding, and electric smelting, the latter in connection with the production of aluminium alloys. The influence of manganese, chromium, aluminium, nickel, etc., in the manufacture of steel, was also touched upon in the address.

It was, however, when the president reached that part of his speech in which he dealt with the appliances of war, that his audience felt they had reached the most important part of his address. He traced the history of the application of gunpowder from early days, and showed how great had been the advance since the last meeting in Leeds, but more especially in quite recent times. When Sir Frederick first actively turned his attention to the subject, Doremus, in America, had proposed the employment in heavy guns, of charges consisting of large pellets of prismatic form. This powder was first used in Russia. The subject was followed up in England, Germany, and Italy. The researches of the Government Committee on Explosives, in which, as is well known, Sir Frederick and Capt. Noble took the leading part, were

[1] Abstract of an address delivered at the annual meeting of the British Association for the Advancement of Science at Leeds, Eng., by the president, Sir Frederick Abel.

also referred to at some length. The "cocoa" powder was produced, which is a prismatic powder containing a very slightly burned charcoal of reddish-brown color, the action of which is comparatively gradual and long sustained. The smoke from this differs but little in volume from that of black powder, but disperses much more rapidly. Even more gradual action yet was required in the case of guns of large caliber, and the brown powder has been modified to meet the case. The desirability of producing a smokeless powder has led many to attempt the use of ammonium nitrate, in which the products of decomposition are, in addition to water-vapor, entirely gaseous. Its deliquescent character has, however, been a formidable obstacle to its application as a component of a useful explosive agent. An ammonium-nitrate powder has, however, been manufactured in Germany which possesses remarkable ballistic properties, and produces comparatively little smoke, which speedily disperses. No great tendency is exhibited by it to absorb moisture from an ordinarily dry, or even somewhat moist, atmosphere; but it readily absorbs water when the hygroscopic condition of the air approaches saturation, and this greatly restricts its use. Sir Frederick next referred to the introduction in France of melinite; but this has now been succeeded by more than one smokeless powder, and the material now in use with the Lebel rifle belongs to a class of nitro-cellulose, or nitro-cotton preparation.

A comparison between the chemical changes attending the burning or explosion of gunpowder, and of the class of nitro-compounds represented by gun-cotton, at once explains the cause of the production of smoke by the former, and of the smokelessness of the latter. While the products of explosion of the nitro-compounds consist exclusively of gases and of water-vapor, gunpowder, being composed of a large proportion of saltpetre or other metallic nitrate, mixed with charred vegetable matter and variable quantities of sulphur, furnishes products of which over 50 per cent are not gaseous, even at high temperatures, and which are in part deposited as a fused solid (which constitutes the fouling in a fire-arm), and in part distributed in an extremely fine state of division through the gases and vapors developed by the explosion, thus giving to these the appearance of smoke as they escape into the air.

So far as smokelessness is concerned, no material can surpass gun-cotton; but, even if the rate of combustion of the fibrous explosive in a fire-arm could be controlled with certainty and uniformity, its application as a safe propulsive agent is attended by so many difficulties, that the non-success of the numerous early attempts to apply it to that purpose is not surprising. Those attempts consisted entirely in varying the density and mechanical condition of employment of the gun-cotton fibre. No difficulty was experienced in thus exercising complete control over the rapidity of burning in the open air; but when the material was strongly confined, as in the bore of a gun, such methods of regulating its explosive force were quite unreliable, as some slight unforeseen variation in the amount and disposition of the air-spaces in the mass would develop very violent action. Much more promising results were subsequently obtained by reducing the fibre to a pulp, as in the ordinary process of making paper, and converting this into highly compressed, homogeneous masses. But although comparatively small charges often gave high velocities of projection, without any indications of injury to the gun, the uniform fulfilment of the conditions essential to safety proved to be beyond absolute control, even in guns of small caliber; and military authorities not being, in those days, alive to the advantages which might accrue from the employment of an entirely smokeless explosive in artillery, experiments in this direction were not persevered in. At the same time, considerable success attended the production of safe and uniform gun-cotton cartridges for sporting-guns and the Martini-Henry rifle.

Sir Frederick next referred to the sporting-powder of Capt. Schultze, the E. C. powder, and the smokeless powder of Mr. Alfred Nobel. He also spoke of the action of camphor and liquid solvents when applied to hardening compressed masses of gun-cotton. The nitro-glycerine powder first produced by Mr. Nobel was, he stated, almost perfectly smokeless, and developed very high energy, accompanied by moderate pressures at the seat of the charge; but it possessed certain practical defects, which led to the development of several modifications of that explosive and various improvements in manufacture. The relative merits of this class of smokeless powder, and of various kinds of nitro-cellulose powder, were under careful investigation in this and other countries, and several more or less formidable difficulties have been met with in their application, in small-arms especially. These arise in part from the comparatively great heat such explosives develop, which increases the erosive effects of the products of explosion, and in part from the more or less complete absence of solid products. The surfaces of the barrel and of the projectile, being left clean after the firing, are in a condition favorable to their close adhesion while the bullet is propelled along the bore, with the consequent establishment of very greatly increased friction. The latter difficulty has been surmounted by more than one expedient at the cost of losing absolute smokelessness.

Our knowledge of the results obtained in France and Germany with the use of smokeless powders in the new rifles and in artillery is somewhat limited. Our own experiments have demonstrated that satisfactory results are attainable. The importance of insuring that the powder shall not be liable to undergo chemical change detrimental to its efficiency or safety, when stored where it may be subject to considerable variations of temperature, necessitates qualities not very easily secured in an explosive agent consisting mainly of the comparatively sensitive nitro-compounds to which the chemist is limited in the production of a smokeless powder. It is possible, therefore, that the extent of use of such a material in our ships, or in our tropical possessions, may have to be limited by the practicability of fulfilling certain special conditions essential to its storage without danger of possible deterioration. If, however, great advantages are likely to attend the employment of a smokeless explosive, it will be well worth while to adopt such special arrangements as may be required for securing these without incurring special dangers. This may prove to be especially necessary in our ships of war, where temperatures so high as to be prejudicial even to ordinary black powder sometimes prevail in the magazines, consequent mainly upon the positions assigned to them in the ships, but which may be guarded against by measures not difficult of application.

The press and other accounts of the wonderful performances of the first smokeless powder adopted by the French engendered a belief that a very great revolution in the conduct of campaigns must result from the introduction of such powders. It was even reported very positively that noiselessness was one of the important attributes of a smokeless powder; and highly colored comparisons have, in consequence, been drawn in service periodicals, and even by some military authorities, between the battles of the past and those of the future. The absence of recoil when a rifle was fired with smokeless powder was another of the marvels reported to attend the use of these new agents of warfare. It need scarcely be said that a closer acquaintance with them has dispelled the credit given to such of the accounts of their supposed qualities as were mythical.

The extensive use which has been made in Germany of smokeless or nearly smokeless powder in one or two special military displays, has, however, afforded interesting indications of the actual change which is likely to be wrought by these new explosives in the conditions under which engagements on land will be fought in the future. Although the German powder is not actually smokeless, the almost transparent film of smoke produced by independent rifle-firing is not visible at a distance of about 300 yards, and the most rapid salvo-firing by a large number of men does not have the effect of obscuring them from distant observers. When machine-guns and field artillery are fired with our own almost absolutely smokeless powder which we are employing, their position is not readily revealed to distant observers by the momentary vivid flash of flame and slight cloud of dust produced. In the naval service, it is, especially for the quick-firing guns, so important for defensive purposes, that a smokeless powder has been anxiously looked for.

The ready and safe attainment of very high velocities of projection through the agency of these new varieties of explosive agents, employed in guns of suitable construction, would appear at first

sight to promise a very important advance in the power of artillery. The practical difficulties attending the utilization of these results are, however, sufficiently formidable to place, at any rate at present, comparatively narrow limits upon our powers of availing ourselves of the advantages in ballistics which they may present. The strength of the gun-carriages, and the character of the arrangements used for absorbing the force of recoil of the gun, need considerable modifications; greater strength and perfection of manufacture are imperative in the case of the shells to be used with charges of a propelling agent, by the firing of which in the gun they may be submitted to comparatively very severe concussions; the increased friction to which portions of the explosive contents of the shell are exposed by the more violent setting-back of the mass may increase the possibility of their accidental ignition before the shell has been projected from the gun; the increase of concussion to which the fuze in the shell is exposed may give rise to a similar risk consequent upon an increased liability to a failure of the mechanical devices which are applied to prevent the igniting arrangement from being set into action prematurely by the shock of the discharge; lastly, the circumstance that the rate of burning of the time-fuze which determines the efficiency of a projected shrapnel shell is materially altered by an increase in the velocity of flight of the shell, also presents a source of difficulty.

One of the first uses for purposes of warfare, to which it was attempted to apply gun-cotton, was as a charge for shells.

The author next again refers to the French melinite, and states that, although the secret of its composition was well kept, it soon transpired that the French authorities were purchasing large quantities of picric acid; and this led to the inference that this substance, known to be explosive, was used in the preparation.

The precise nature of melinite, Sir Frederick continued, appears to be still only known to the French authorities. It is asserted to be a mixture of picric acid with some material imparting to it greater power; but accounts of accidents which have occurred, even quite recently, in the handling of shells charged with that material, appear to show, that, in point of safety or stability, it is decidedly inferior to simple picric acid. Reliable as the latter is in this respect, its employment is, however, not unattended with the difficulties and risks which have to be encountered in the use, in shells, of other especially violent explosives. Future experience in actual warfare can alone determine decisively the relative value of violent explosive agents, and of the comparatively slow explosive, gunpowder, for use in shells; it is certain, however, that the latter still presents distinct advantages in some directions, and that there is no present prospect of its being more than partially superseded as an explosive for shells. Referring to submarine mines and locomotive torpedoes, such as the Whitehead and Brennan torpedoes, Sir Frederick stated that progress recently made in the practical development of explosive agents has not resulted in the provision of a material which equals wet compressed gun-cotton in combining with great destructive power the safety to those who have to deal with these weapons.

The president next proceeded to deal with the question of explosions in mines, dwelling at some length on the use of naked lights and safety-lamps,—a subject upon which he is, as is well known, an authority. The petroleum industry next occupied his attention, the following statistics being given of the product of the United States:—

In 1859, 5,000 barrels (of forty-two American gallons) were produced; in the following year the production increased to 500,000 barrels; while in the next year (1861) it exceeded 2,000,000 barrels, at which figure it remained, with slight fluctuations, until 1865. The supply then continued to increase gradually, until, in 1874, it amounted to nearly 11,000,000 barrels. In 1880 it amounted to over 26,000,000 barrels, and in 1882 it reached 31,000,000. Since then the supply furnished by the United States has fallen somewhat, and last year it amounted to 21,500,000 barrels. In addition to the petroleum raised in Pennsylvania, there is now a very large production in the State of Ohio, which is, however, transported by pipe-lines in great quantities to Chicago, for use as liquid fuel in industrial operations.

The production of crude petroleum in Russia was next referred to in the address. In 1863 the supplies from the Baku district amounted to 5,018 tons. They increased to somewhat more than double during the succeeding five years. In 1869 and following three years the production reached about 27,000 tons annually, and in 1873 it was about 64,000 tons; three years later, 153,000 tons were produced; and in the following five years there was a steady annual increase, until, in 1882, the production amounted to 677,269 tons; in 1884 it considerably exceeded 1,000,000 tons; and last year it was about 3,300,000 tons. The consumption of crude petroleum as fuel for locomotive purposes has, moreover, now assumed very large proportions in Russia, and many millions of gallons are annually consumed in working the vast system of railways on both sides of the Caspian Sea.

The imported refined petroleum used in this country in lamps for lighting, heating, and cooking, was exclusively American until within the last few years, but a very large proportion of present supplies comes from Russia. The imports of kerosene into London and the chief ports of the United Kingdom during 1889 amounted to 1,116,205 barrels of United States oil, and 771,227 barrels of Russian oil. During the same period the out-turn of mineral oil for use in lamps by the Scottish Shale Oil Companies probably amounted to about 500,000 barrels.

The prospects of less-known or less-worked sources of supply in other parts of the world were next touched upon. The subject led up to some remarks on the discovery and application of natural gas, which, in turn, brought water-gas before the meeting. No address delivered to a scientific body is now complete without some reference to technical education, and Sir Frederick naturally devoted a few paragraphs to that subject. The Imperial Institute also could not with decency have been excluded from an important delivery by its organizing secretary. Sir Frederick, however, with great moderation, confined himself to a few paragraphs on the subject. The address was of great interest, and was listened to by a large audience. It could, of course, have been made doubly instructive had its author dealt with Cordite, among the other explosives upon which he spoke; but this naturally would have been a breach of the conventionalities, for which, no doubt, Sir Frederick was sufficiently thankful.

HEALTH MATTERS.

Danger in Exercise.

THE *Providence Journal* quotes Dr. Patton, chief surgeon of the National Soldiers' Home at Dayton, O., as saying, in an interview he had in Pittsburgh, that, of the five thousand soldiers in the Dayton home, "fully 80 per cent are suffering from heart-disease in one form or another, due to the forced physical exertion of the campaigns;" and he made the prediction, according to the *Medical and Surgical Reporter*, that as large a percentage of the athletes of to-day will be found twenty-five years from now to be victims of heart-disease, resulting from the muscular strains that they force themselves to undergo. As for the likelihood of exercise to prolong life, it may be said, that, according to the statistics of M. de Solaiville, there are more people living in France to-day who have passed the age of sixty than there are in England, the home of athletic sports; and there is probably no nation in Europe more adverse to muscular cultivation for its own sake than the French. Great athletes die young; and a mortality list of Oxford rowing-men, published a few years ago, showed that a comparatively small percentage of them lived out the allotted lifetime. Dr. Jastrow has demonstrated in some very elaborate statistics that men of thought live, on an average, three years and a half longer than men in the ordinary vocations of life.

Decrease of Tuberculosis in England.

There is an instructive lesson in the English mortality returns from tuberculosis for the last forty years, says the *Medical and Surgical Reporter*. In the ten years from 1851 to 1860 the number of deaths from tuberculosis in persons from 15 to 45 years of age amounted to 3,943 in every million; from 1861 to 1870 it had fallen to 3,711; from 1871 to 1880 it was 3,194; and from 1881 to 1887 it did not exceed 2,666. The decreased rate is more marked in the female than in the male sex.

NOTES AND NEWS.

In August, 1891, a meeting of the Congrès International des Sciences Géographiques will be held at Berne, Switzerland. Societies, or their members individually, are invited to take part in the congress, and to communicate their views on the subjects that should appear in the programme. The management is in the hands of the Geographical Society of Berne.

— A thunder-storm is generally believed to be a bad thing for a dairy. An Italian *savant*, Professor G. Tolomei, has made some experiments on the relation of electricity to the souring of milk. He found, according to *The Boston Medical and Surgical Journal*, that the passage of an electric current directly through the milk not only did not hasten, but actually delayed acidulation; milk so treated not becoming sour until from the sixth to the ninth day, whereas milk not so electrified became markedly acid on the third day. When, however, the surface of a quantity of milk was brought close under the two balls of a Holtz machine, the milk soon became sour, and this effect he attributes to the ozone generated.

— The Caucasus papers relate an interesting case of globular lightning which was witnessed by a party of geodesists on the summit of the Böhul Mountain, 12,000 feet above the sea. About 3 P.M., as related by *Nature*, dense clouds of a dark-violet color began to rise from the gorges beneath. At 8 P.M. there was rain, which was soon followed by hail and lightning. An extremely bright violet ball, surrounded with rays which were, the party says, about two yards long, struck the top of the peak. A second and a third followed, and the whole summit of the peak was soon covered with an electric light, which lasted no less than four hours. The party, with one exception, crawled down the slope of the peak to a better-sheltered place, situated a few yards beneath. The one who remained was M. Tatosoff. He was considered dead, but proved to have been only injured by the first stroke of lightning, which had pierced his sheepskin coat and shirt, and burned the skin on his chest, sides, and back. At midnight the second camp was struck by globular lightning of the same character, and two persons slightly felt its effects.

— A study of five years' thunder-storms (1882–86) on the Hungarian plain has been recently made by M. Hegyfoky, says *Nature* of Sept. 4, 1890. The following points in his paper (communicated to the Hungarian Academy) may be noted. The days of thunder-storm were those on which thunder was observed, and they formed 16.4 per cent of all days from April to September. The air pressure on those days sank about 2 millimetres under the normal, morning and evening. The less the pressure, the greater the probability of thunder-storm. The temperature (estimated by the maximum thermometer) was higher than that of all days of the season indicated; and the moisture and cloudiness were similarly in excess. The wind blew about mid-day more softly, and in the evening more strongly than usual. It went round, as a rule, from the south-east by the south to the west and north-west. The clouds came oftener than usual from the south-east and south-west quadrants, so that the centre was generally north af the station. Nearly half of the season's rainfall was on days of thunder-storm. Hail fell on 11 days, on one of which there was no thunder-storm. There were most thunder-storms in June (59 out of 199). The June of 1886 had as many as 26. The commencement of a thunder-storm (first thunder) occurred most often from 2 to 5 P.M. Towards the end of the season the thunder-storms tend to come later in the day. When the pressure falls under the mean of the season (752.4 millimetres), the thunder-storms last longer than when it is above the mean. The path was in most cases from south-west or west, and in most cases coincided with that of both lower and upper clouds, but in several cases only with that of the lower or upper. After the first thunder the meteorological elements are usually subject to great changes, most marked as the storm nears the zenith: rain falls, wind rises, and alters quickly in direction; temperature and vapor-pressure fall; relative humidity, cloud, and pressure increase. As the storm withdraws there is a return to the normal. Various other points are considered. The author accepts Sohncke's theory, that the electricity of thunder-storms is due to friction of water-drops on ice.

— Dr. G. W. Barr writes, in the *Therapeutic Gazette*, that iced tea has none of the physiological action of theine if it is kept ice-cold for a short time. He says that he has known a man of nervous temperament, who is kept awake all night by a single cup of tea, to drink a half-gallon of iced tea during the evening, and sleep soundly at his usual time of retiring. Others, made very nervous by hot tea, have been able to drink large quantities of iced tea with no appreciable effect. If the tea-grounds are allowed to remain in the liquid, the iced tea is usually kept long enough before drinking to dissolve more tannin than is usual in hot tea: hence the tea should be strained as soon as removed from the fire.

— The process of electric welding invented by Professor Elihu Thomson, which has been so widely used in its application to numerous manufactures pertaining to the arts of peace, has now been applied to the production of certain munitions of war in a very remarkable manner. The problem in making a shell for armor-piercing purposes, says *Engineering* of Aug. 29, has been to select a grade of steel with a view to its possessing the hardest point for armor-piercing purposes consistent with a chamber whose walls shall not be so hard as to crumble on striking a heavy mass. The metal selected for such purposes has been very naturally the result of a compromise in the endeavor to procure a metal which would give as hard a point as feasible under the circumstances; and yet the limitations of all materials are such that neither object has been perfectly accomplished, and the excessive hardness of the inside of ordinary cast-steel projectiles renders the work of clearing out the interior of the chamber very expensive. This application of the electric welding process to the production of shells has reached very satisfactory results, entirely beyond those achieved by methods of manufacture hitherto carried on. The armor-piercing point of the shell is made of hard steel, shaped in the conical form suited for such a purpose. To this is attached a tube of mild steel, forming the chamber. The plastic state of the metal when the two pieces are pressed together in the act of electric welding forms a slight enlargement without cutting away any of the walls of the chamber. The butt of the projectile is made of a piece of mild steel, which is somewhat harder than the cylindrical walls of the chamber, and is shaped to a cup form by hydraulic forging. The slight exudation of the metal at the walls on the inside produces an interior ring, which is a material increase in the strength of the projectile. For Shrapnel, the thin metal screen between the charge and the bullet-case is placed in position before the head is welded to the cylindrical chamber of the projectile, and readily joined in place in the act of welding. This new application of the electric-welding process was invented by Lieut. W. M. Wood of the United States Navy, who has received a year's leave of absence from the government, and is in the mean time associated with the Thomson Electric Welding Company. It is stated that the United States Government is ready to contract for a very large supply of these electric shells as soon as the machinery can be made for their manufacture.

— A new process of bleaching by electricity has been devised for the textile trades. By its use the need of bleaching powder is done away with. The process, as described in *Engineering*, is as follows: the current is taken direct from an engine and dynamo to electrodes placed in a wooden tank containing a solution consisting of 64 pounds of calcined magnesia, 357 pounds of hydrochloric acid, specific gravity 1.16, and 300 gallons of water, which solution has no bleaching properties; in other words, no chlorine is present. After passing an electro-motive force of six volts, and a current of 120 ampères, for 100 hours, the solution contains .25 of one per cent of fixed chlorine, which bleaches yarn and tow in as many hours as it now takes days, without impairing the strength of the material. The electrodes used consist of three cathodes of sheet copper, each 27 inches by 18 inches. These are connected to the negative terminal of the dynamo. The anode employed is "lithanode," a peroxide of lead, which is specially adapted for this particular purpose, all other metals being attacked by chlorine, which disqualifies them for all purposes of electrolysis where chlorine is evolved. The anodes are 7 inches by 4 inches, and are seventy-two in number, and are connected to the positive terminal. These electrodes are ranged along the sides

and bottom of the tank, and are protected from the yarn to be bleached by a wooden framework. What chemical re-actions take place during the 100 hours required for charging the solution cannot be accurately determined; but that the system is regenerative there can be little doubt, owing to the fact that bleaching is performed by the fixed chlorine, and consequently there can be no loss of free chlorine, as is the case with bleaching-powder.

—An Italian correspondent writes to the *Lancet*, "An occurrence as strange as it is tragic is just reported from Sicily. At Milazzo, a seaport of that island, a bark had put in after a voyage from Genoa, having in her hold, by way of ballast, a number of wine-butts, which, incrusted on their insides with tartrates, had, to give them the necessary weight, been filled with salt water. On coming into harbor, these butts had to be emptied before refilling them with wine; and for that purpose one of the crew, having raised the trap door admitting to the hold, went down to tap them and run their contents through the drain-holes into the sea. No sooner had the bungs been knocked out than forth rushed a poisonous gas, which took the man's breath away and made him fall, a corpse, into the escaping salt water. In ignorance of what had happened, a second mariner, then a third, and finally a fourth, went below; each, in turn, to be asphyxiated instantaneously, and to fall headlong into the salt water, now of some depth in the hold. As the butts continued to empty, the poisonous gas increased; and the captain, wondering that none of the four men re-appeared, went, out of curiosity, to the trap-door, only to receive a tremendous rush of the gas in his face, and to fall below, asphyxiated and drowned. The cabin-boy, the sole survivor out of a crew of six, seeing what had happened, shouted wildly for help to the bystanders on the quay. Assistance soon came; and the stifling fumes, by this time escaped or so diluted as to be innocuous, admitted of the new-comers looking down into the hold. There were the five men, quite dead, floating in the water. The corpses were hoisted up with ropes; and the medical officers, who had now arrived, pronounced them past recovery." We give this story for what it is worth.

— The following sensational and untrue paragraph (dated St. Louis, Sept. 11) has been going the rounds of the press, evidently in the interest of the producers of Ceylon tea, who are trying to make a market in this country for their tea, says the *American Grocer*: "G. E. Martin, who is a resident of Ceylon and an extensive coffee-planter there, owning, with his brother, two of the largest estates on the island, was interviewed here to-day, and confirms the report of the failure of the coffee-crop. He said, 'I cannot explain how, but coffee will no longer make a good crop in the Far East, not only in Ceylon and Arabia, but also in the other coffee raising districts. I have just received a letter from my father, in which he informs me that our estate must immediately be put into tea and fruit, as there is no longer any chance of making a profitable coffee-crop. We shall lose fifty thousand dollars this year on our crop, and it is generally so throughout the coffee-growing districts. In South America, which I visited before coming to this country, the same situation prevails. The crop will not grow. I can see no other result than that we must stop drinking coffee. We can no longer raise it, and the countries where it will grow are already exhausted.'" A few facts will show the utter fallacy of the statement, the only part of which that is true being the fact that Ceylon is out of the race as a producer of coffee. It is true that in Ceylon the industry has declined, the exports of coffee decreasing from a maximum crop from which 995,493 hundredweight were exported in 1873, to 86,440 hundredweight in 1889, the decrease being due to a disease which destroyed the trees. In 1873, when the Ceylon crop was the largest on record, the production in Brazil permitted exports of about 150,000 tons, against an average annual export for the five years 1885–89 of 319,281 tons,—an increase in production of over 100 per cent. In Sumatra the crop of recent years has been below the average. In Java the supply does not increase, the crop varying, as it does in all countries, above and below an average yield, which for the eleven years permitted an average annual export of 1,167,009 piculs. The production of the world in 1888–89 was estimated by W. Schoffer & Co., high authorities in Europe and this country, at 12,831,600 centners, or 631,489 tons,—quite an advance over 1879, when N. P. Van Den Berg of Batavia estimated the production at 483,087 tons; which, in turn, was a large advance over the 324,787 tons produced in 1860. Coffee-plantations are being extended in Mexico and the different countries of Central and South America, because there is at present, and has been for several years, an immense profit in coffee-culture, high prices placing a premium on the extension of the industry. In a few years more we look for a production far enough ahead of the world's requirements to again inaugurate an era of low-priced coffee, notwithstanding the Ceylon estates are no longer productive.

—We learn from *Nature* that countless swarms of rats periodically make their appearance in the bush country of the South Island, New Zealand. They invariably come in the spring, and apparently periods of about four years intervene between their visits. In a paper published in the new volume of the "Transactions and Proceedings of the New Zealand Institute," Mr. Joseph Rutland brings together some interesting notes on the bush-rat (*Mus maorium*). In size and general appearance it differs much from the common brown rat. The average weight of full-grown specimens is about two ounces. The fur on the upper portions of the body is dark brown, inclining to black; on the lower portions, white or grayish white. The head is shorter, the snout less sharp, and the countenance less fierce, than in the brown species. On the open ground, bush-rats move comparatively slowly, evidently finding much difficulty in surmounting clods and other impediments: hence they are easily taken and destroyed. In running they do not arch the back as much as the brown rat. This awkwardness on the ground is at once exchanged for extreme activity when they climb trees. These they ascend with the nimbleness of flies, running out to the very extremities of the branches with amazing quickness: hence, when pursued, they invariably make for trees, if any are within reach. The instinct which impels them to seek safety by leaving the ground is evidently strong. A rat, on being disturbed by a plough, ran for a while before the moving implement, and then up the horse-reins, which were dragging along the ground. Another peculiarity of these animals is, that, when suddenly startled or pursued, they cry out with fear, thus betraying their whereabouts,—an indiscretion of which the common rat is never guilty.

—In a paper recently read before the Vienna Academy, says *Nature* of Aug. 28, 1890, Herren Elster and Geitel gave the results of a year and a half's observations of atmospheric electricity on the north side of Wolfenbüttel (bordering an extensive meadow). They used a stand carrying a petroleum-flame, and connected by insulated wire with an electroscope. A marked difference was found in the phenomena of spring, summer, and autumn, on the one hand, and winter on the other. In the former the daily variation of the fall of potential showed a distinct maximum between 8 and 9 A.M., as Exner found at St. Gilgen, and a distinct minimum between 5 and 6 P.M., whereas Exner found a maximum about 6. In winter there is great irregularity; but a weak minimum occurs about 11 A.M., and a more decided maximum about 7 P.M. It appears to the authors that other factors than humidity, with which Exner seeks to explain the variations, are concerned in the case. When the temperature goes below zero, cold mist being then generally present, there is often a rather sharp rise in the values, the aqueous vapor having then less action. Rainfall in a neighboring region lowers the fall of potential both in winter and summer, and a disturbance of the normal course will announce a coming change in places still unclouded. Snow, it seems, rather raises the values. It has been shown by Linss that the course of the fall of potential is inversely as the coefficient of dispersion of the air for electricity; which, again, depends not only on the dust and aqueous vapor present, but also, according to Arrhenius's theory, on a sort of electrolytic or dissociative action of the sun's rays on the atmosphere (thus it has been shown that electricity escapes from a conductor under the influence of ultra-violet rays). The authors find their results support this latter view. They consider that the electric processes during formation of precipitates are the chief cause of the disturbance of the normal condition.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

Vol. XVI. NEW YORK, September 19, 1890. No. 398.

CONTENTS:

LOW WATER IN BOILERS.

The Manchester Steam Users' Association for the Prevention of Steam-Boiler Explosions and for the Attainment of Economy in the Application of Steam publishes (Manchester, 1889) the report of its chief engineer, Mr. Lavington E. Fletcher, on a series of experiments conducted by him to determine the much-debated question of the advisability of throwing cold water into a steam-boiler in which portions of the heating surfaces had become red-hot through shortness of water. The same investigator had, as early as 1867, performed similar experiments to those here described, on simple household boilers, and corroborated a deduction, coming of occasional accidental illustrations of the same phenomena, that the introduction of cold water into such boilers may destroy them by producing strain and seam-rips by the great and irregular contraction thus caused.[1] The special object of the recent experiments was to ascertain precisely what occurred when the furnace-crowns of fire-box boilers were left bare of water and overheated, and then flooded with feed-water.

A Lancashire boiler (7 feet diameter, 27 feet long), with furnaces 3 feet in diameter and grates 6 feet long, was used for the work. It was of $\frac{7}{16}$-inch iron, of ordinary construction, and set in the usual manner. Two feed-pipes were used,—the one, as commonly arranged, to discharge its contents behind the bridge; the other a special construction, throwing the water directly upon the crown of the furnace. Suitable barricades and "bomb-proofs" protected the observers and others from danger in case of explosion.

[1] Mechanics' Magazine, May, 1867; London Engineer, March 15, 1867, p. 228.

Thus arranged, the boiler was subjected to repeated experiment; the water being blown out below the level of the furnace-crown, sometimes to a greater, sometimes to a less extent; the feed-water introduced, sometimes by the regular feed-pipe, sometimes by the showering arrangement; the pressures were sometimes high, sometimes low; the safety-valves sometimes open, sometimes closed. But in no case was the boiler injured by the introduction of the feed, and no explosion took place. In some instances the furnace-crowns came down; but this was always the effect of pressure, and not of the introduction of cold water, the latter invariably reducing the pressure promptly, except where the pressures were initially very low, or nearly atmospheric, in which case the introduction of the feed-water occasionally caused slight but momentary rise of pressure.

The conclusion of the experimenter is, that "these experiments put to rout the generally entertained opinion that showering cold water on red-hot furnace-crowns would cause the 'instantaneous disengagement of an immense volume of steam,' which would act 'like gunpowder,' overpowering the safety-valves however efficient, tearing the outer shell of the boiler to pieces, and hurling the fragments to a considerable distance."

The writer of the report goes on to say, "It would have been well if they had been tried some fifty years ago, in the days when high-pressure steam was young, when the cause of steam-boiler explosions was shrouded in mystery, and the easiest way out of the dilemma was to blame the stoker." But such experiments *have* been repeatedly tried in earlier years; and some of the most interesting and important, more than a half-century ago, by the Franklin Institute in this country, exhibited precisely the facts here again shown.[1] The later work of the United States Board of 1875 was but irregularly and unsatisfactorily published; but our information, such as it is, leads to nearly the same conclusions, with this important qualification: that while, as a rule, explosion does not result on introducing feed-water into a red-hot boiler, it nevertheless may, and sometimes does, take place. Mr. Fletcher concludes from these latest experiments that the right thing to do, on discovering low water in a boiler, is to put on the feed at once.

It would seem that this statement should be given the form, "The probabilities of fatal accident are slight in such cases, and the wiser plan is to at once put on the feed-water in full force, *then* proceed to dampen the fires. We would not draw them; that being certain to, at least momentarily, greatly increase the heat of the furnace."[2]

The report of the Franklin Institute was made to the secretary of the treasury in 1836. The conclusion reached was that the injection of water upon the heated surfaces of the experimental boiler produced a sudden and considerable rise of pressure.[3]

The work of the government board led to the conclusion by Dr. Thurston that "the overheating of the metal of a boiler in consequence of low water may or may not produce explosion, accordingly as the sheet is more or less weakened, or as the amount of steam made by the overflow of the dry heated area by water is greater or less."[4]

There would seem to be no question, in the light of our present knowledge, that low water, in some cases, may produce, or at least initiate, disastrous explosions; while there is as little doubt that it is only under conditions which are very rare, and very difficult of production, that such result may be expected to occur. The contributions of Mr. Fletcher to the literature and the facts of this important matter are as welcome as they are interesting and valuable.

[1] Journal Franklin Institute, vol. xvii. 1837.

[2] Thurston's Manual of the Steam-Boiler, p. 614, § 292.

[3] *Ibid.*, p. 635.

[4] *Ibid.*, p. 643. See also, especially, pp. 567, 568, arts. 277–279.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Dr. A. Graham Bell's Studies on the Deaf.

CALLING a statement a mistake does not make it one. Permit me to respond briefly to what are called my mistakes:—

1. The statement (p. 85) which Dr. Bell denies, was accompanied by reference to the authority for my quotation. It was taken from the *British Medical Journal* of May 11, 1889, a reputable English periodical, and has since been quoted in the *British Quarterly Review of Deaf Mute Education.* My responsibility ceases upon the production of such evidence. The misstatement cannot, by the wildest liberty of imagination, properly be called mine.

2. The so-called mistakes in the final paragraph (p. 119) can easily be detected, if they exist, for the official sources of information are given. The papers presented to the British House of Commons on deaf-mute matters contain a report from the United States, dated Oct. 5, 1886 (pp. 51–55).

In June, 1884, at a convention of oral teachers held in New York City, of which Dr. Bell was permanent chairman, F. H. Wines, Esq., the special census officer in charge of statistics of this character, said, "There must be in the United States, I think, not less than five thousand children, who are of proper age to attend school, who have never seen the inside of any institution" (*Official Report of Convention,* p. 5). Several months later, at the Gallaudet Centennial in Philadelphia, Dr. Bell used the following language: "In 1880, with all our magnificent institutions, and with all our beneficence, we still had fifteen thousand children of school age in the country; and in all our institutions and schools put together there were only a little over five thousand, and many of these were over the school age" (*Silent World*, Philadelphia; and *Dr. Bell's Speech at Gallaudet Conference of Principals,* p. 16). These two extracts and the "Report to the British House of Commons" are sufficient evidence of the correctness of my final paragraph (p. 119).

3. I am also condemned for not giving the statement of what the theory of a deaf-mute race is. It ought to be remembered that the article on "Scientific Testimony," reprinted in your columns, appeared originally in the *American Annals of the Deaf.* The readers of that journal are perfectly familiar with what the theory of a deaf-mute race is, and the statement of it there would be altogether unnecessary. It was Dr. Bell himself who first suggested the printing of this article in *Science;* and it is difficult to understand how he can now turn upon the writer, and condemn what he is himself responsible for, so far as the wider publicity of the article is concerned.

4. But the *gravamen* of my offence, "the climax of my numerous mistakes," as Dr. Bell terms it, is that I have attributed the theory of a deaf-mute race to him. It would certainly be inexcusable in a teacher of the Hartford school not to know that Rev. William Turner first suggested this theory, if such a teacher could be found. Does the doctor really believe that it is the culmination of my errors that I did not charge him with borrowing this theory? I have nowhere said he originated it. According to this rule, we must never speak of the Darwinian theory, for it is well known that it had already been suggested long before it had been elaborated by Darwin. Theories take the names of their most illustrious expounders. It was in this sense, without the least suspicion of an invidious suggestion, that I, in common with the press and the colloquial habit of the country, spoke of Professor Bell's theory of a deaf-mute race. I confess to a considerable degree of mortification in finding myself obliged to deal with matters of so trivial a character as the charges this letter contains; but, when the head and front of my offending turns upon so minute a point as the proper designation of a theory which has been presented to the public by Professor Bell, I may well feel some degree of satisfaction with the real question of which these side issues are mere cobwebs. I hope to be able in a few weeks to present a few thoughts on hereditary deafness; but I shall not again reply to charges of misstatements, unless I have been guilty of some inadvertence which does injustice.

REV. W. G. JENKINS.

Hartford, Conn., Sept. 8.

I HAVE read the review of the "Facts and Opinions" respecting the deaf, published by Mr. A. Graham Bell, which appeared in your issue of Aug. 15. The reviewer, Mr. W. G. Jenkins of Hartford, quotes my opinion as to the cause of deafness, which is characteristic of many batrachians, which was, that it is due to disuse which follows the absence of sound in the subterranean and subaquatic region which they inhabit. The reviewer then goes on to point out that there is no analogy between such animals and the deaf-mutes among mankind, who live, like their fellowmen, in the midst of sounds.

Mr. Jenkins has overlooked the questions put by Mr. Bell, and hence has missed the significance of the answer, in my case at least. The first question was whether it was thought probable that a race of human deaf-mutes could be established. My reply was that I thought that such a race could be established. My reasons were, first, the analogy of the batrachians and other *Vertebrata;* and, second, the probability that by continuous intermarriage such a peculiarity could become established as congenital. I did not offer any opinion as to how the deafness might originate in mankind; for on this subject I had, and have now, no sufficient information. As to the question of the transmittal of such a character, your readers are referred to my essay on "Inheritance in Evolution," which appeared in the *American Naturalist* for December, 1889.

E. D. COPE.

Philadelphia, Sept. 5.

The "Barking Sands" of the Hawaiian Islands.

ABOUT a year ago *Nature* printed my letter from Cairo, giving a condensed account of an examination of the Mountain of the Bell (*Jebel Nagous*) on the Gulf of Suez, and of the acoustic phenomenon from which it is named. In continuation of my researches on sonorous sand, which are conducted jointly with Dr. Alexis A. Julien of New York, I have now visited the so called "barking sands" on the island of Kauai. These are mentioned in the works of several travellers (Bates, Frink, Bird, Nordhoff, and others), and have a world-wide fame as a natural curiosity; but the printed accounts are rather meagre in details, and show their authors to have been unacquainted with similar phenomena elsewhere.

On the south coast of Kauai, in the district of Mana, sand-dunes attaining a height of over one hundred feet extend for a mile or more nearly parallel to the sea, and cover hundreds of acres with the water-worn and wind-blown fragments of shells and coral. The dunes are terminated on the west by bold cliffs (*Pali*) whose base is washed by the sea; at the east end the range terminates in a dune more symmetrical in shape than the majority, having on the land side the appearance of a broadened truncated cone. The sands on the top and on the landward slope of this dune (being about 100 yards from the sea) possess remarkable acoustic properties, likened to the bark of a dog. The dune has a maximum height of 108 feet, but the slope of sonorous sand is only 60 feet above the level field on which it is encroaching. At its steepest part, the angle being quite uniformly 31°, the sand has a notable mobility when perfectly dry; and on disturbing its equilibrium it rolls in wavelets down the incline, emitting at the same time a deep bass note of a tremulous character. My companion thought the sound resembled the hum of a buzz-saw in a planing-mill. A vibration is sometimes perceived in the hands or feet of the person moving the sand. The magnitude of the sound is dependent upon the quantity of sand moved, and probably to a certain extent upon the temperature. The dryer the sand, the greater the amount possessing mobility, and the louder the sound. At the time of my visit the sand was dry to the depth of four or five inches. Its temperature three inches beneath the surface was 87° F., that of the air being 83° in the shade (4.30 P.M.).

When a large mass of sand was moved downward, I heard the sound at a distance of 105 feet from the base, a light wind blowing at right angles to the direction. On one occasion horses standing close to the base were disturbed by the rumbling sound. When the sand is clapped between the hands, a slight hoot like sound is heard; but a louder sound is produced by confining it in a bag, dividing the contents into two parts and bringing them together violently. This I had found to be the best way of testing seashore sand as to its sonorousness. The sand on the top of the dune is wind-furrowed, and generally coarser than that of the slope of 31°; but this also yielded a sound of unmistakable character when so tested. A bag full of sand will preserve its power for some time, especially if not too frequently manipulated. A creeping vine with a blue or purple blossom (*kolokolo*) thrives on these dunes, and interrupts the sounding slope. I found the main slope 120 feet long at its base; but the places not covered by this vine gave sounds at intervals 160 paces westward. At 94 paces further the sand was non-sonorous.

The native Hawaiians call this place *Nohili*, a word of no specific meaning, and attribute the sound caused by the sand to the spirits of the dead (*uhane*), who grumble at being disturbed; sand-dunes being commonly used for burial-places, especially in early times, as bleached skeletons and well-preserved skulls at several places abundantly show.

Sand of similar properties is reported to occur at *Haula*, about three miles east of Koloa, Kauai. This I did not visit, but, prompted by information communicated by the Hon. Vladimar Knudsen of Waiawa, I crossed the channel to the little-visited island of Niihau. On the western coast of this islet, at a place called *Kaluakahua*, sonorous sand occurs on the land side of a dune about 100 feet high, and at several points for 600 to 800 feet along the coast. On the chief slope, 36 feet high, the sand has the same mobility, lies at the same angle, and gives when disturbed the same note as the sand of Kauai, but less strong, the slope being so much lower. This locality has been known to the residents of the island for many years, but has never before been announced in print. This range of dunes, driven before the high winds, is advancing southward, and has already covered the road formerly skirting the coast.

The observations made at these places are of especial interest, because they confirm views already advanced by Dr. Julien and myself with regard to the identity of the phenomena on sea-beaches and on hill-sides in arid regions (*Jebel Nagous*, *Rig-i-Rawan*, etc.). The sand of the Hawaiian Islands possesses the acoustic properties of both classes of places; it gives out the same note as that of Jebel Nagous when rolling down the slope, and it yields a peculiar hoot-like sound when struck together in a bag, like the sands of Eigg, of Manchester (Mass.), and other sea-beaches,—a property that the sand of Jebel Nagous does not possess. These Hawaiian sands also show how completely independent of material is the acoustic quality, for they are wholly carbonate of lime, whereas sonorous sands of all other localities known to us (now over one hundred in number) are silicious, being either pure silex or a mixture of the same with silicates, as felspar.

The theory proposed by Dr. Julien and myself to explain the sonorousness has been editorially noticed in *Nature*, but may properly be briefly stated in this connection. We believe the sonorousness in sands of sea-beaches and of deserts to be connected with thin pellicles or films of air, or of gases thence derived, deposited and condensed upon the surface of the sand-grains during gradual evaporation after wetting by the seas, lakes, or rains. By virtue of these films the sand-grains become separated by elastic cushions of condensed gases, capable of considerable vibration, and whose thickness we have approximately determined. The extent of the vibrations, and the volume and pitch of the sounds thereby produced after any quick disturbance of the sand, we also find to be largely dependent upon the forms, structures, and surfaces of the sand-grains, and especially upon their purity, or freedom from fine silt or dust ("Proceedings American Association for the Advancement of Science," 38, 1889).

I should be lacking in courtesy if I closed this letter without expressing my great obligations to Mr. H. P. Faye of Mana, and to Mr. George S. Gay of Niihau, for both a generous hospitality and a sympathetic assistance in carrying out my investigations.

H. CARRINGTON BOLTON.

Honolulu, H.I., May 26.

BOOK-REVIEWS.

Civil Government in the United States considered with Some Reference to its Origins. By JOHN FISKE. New York, Houghton, Mifflin, & Co. 12°. $1.

THIS is not such a work as we expected from Mr. Fiske. We thought when we took it up that we should find it a philosophical treatise on the nature and functions of government, but that is just what it is not. The author does, indeed, ask what government is, but dismisses the question in a single sentence; there is nothing in the book about the nature and uses of law; and the ethical principles that lie at the basis of civil society are never once alluded to. The work is purely descriptive and historical, and treats, not of government, but of governmental machinery only. Moreover, one-half the book is devoted to municipal government,—to the town, the city, and the county,—the city alone receiving as much attention as the State. But such a mode of treatment magnifies the work of the municipalities out of all proportion to its importance. The essential element in our political system is the State, and the municipalities are merely agencies of the State for certain administrative purposes.

But though we cannot agree with Mr. Fiske's conception of his subject, yet the work he has actually done is well done. He has given a description of the various agencies of government in the United States which is both accurate and clear, and in a smaller space than we should have thought possible. The book also conveys a good deal of interesting historical information, especially in the part devoted to the town and the county. Questions for pupils, and suggestions for teachers, adapt the work for use in schools; and its value is increased by an appendix containing the Articles of Confederation, the National Constitution, a translation of the Great Charter of King John, and other interesting documents.

Die Furcht. Von A. MOSSO. Aus dem Italienischen übersetzt von W. Finger. Deutsche Original-Ausgabe, mit 7 Holzschmitten und 2 Lichtdruck-Tafeln. Leipzig, Verlag von S. Hirzel. 1889.

THERE are two classes of scientific men. To the one class belong the enthusiastic, absorbed searchers after truth, who are driven by an inborn impulse to grapple with Nature, and who find their highest happiness in wresting her secrets from her. They are unfortunately in the minority, for they are the pioneers of science. The other class are many, and range in culture from learned men down to those who read for the sake of a subject to talk about. The purpose of the work and study of the latter is social influence. Both classes are useful, the second acting as the interpreter of the truths which the former have extorted from nature.

It is seldom that the scientific investigator has personally the time and the necessary contact with the masses of the people to enable him to popularize his own observations and experiments. Mosso, however, has undertaken the task with Italian geniality. The charm of his book is that he is himself so enthusiastic in and enraptured by his scientific work that he must seek to interest others also. He says of it, "It is a work full of patience, The only difficulty consists in gradually learning to understand Nature's speech; to find ways and means of questioning her, and compelling her to answer us. In this struggle in which we, modest pygmies, are continually striving to grasp the secret of life, there are delightful moments, lights and shadows, which excite the imagination of scientist and artist."

His enthusiasm does not cause him to forget that he is writing for the people as well as for his colleagues in science. Though his language is as free of technical terms as possible, the work is pregnant with scientific observations and experiments, chiefly the result of his own study, some of them as yet unpublished. The chapters in which he describes the pulsations of the blood in the

brain are fascinating.[1] Three patients came to him whose skulls had been so disturbed by disease or accident that he was able to see and register the pulsations of their brains through the window-like opening thus formed. The observations were made in sleeping and in waking moments. The registered curves proved that every emotion, every thought, is accompanied by an increase in the volume of blood in the brain. The severer the mental work, the more violent the emotion, the stormier were the pulsations of the brain. Another interesting series of experiments which the author describes are those made with an originally constructed balance, by means of which he was able to register the respiratory movements and the flow of the blood from the feet to the head. The table of the balance was large and wide enough for a man to lie at full length upon it. It was upon this table that Mosso observed that a sudden noise caused the blood of a man asleep upon the table to leave the lower extremities and flow to the head; further, that the head end of the balance sank deeper during the solution of a difficult mathematical problem than when the mind was less severely occupied. By these two methods, as well as by means of the more common methods of registering the beat of the heart and the respiratory movements of the lungs, he found that any sensation exciting fear sends the blood to the brain, increases the strength and frequency of the heart-beat, and alters the regularity of the breathing. He describes the effect upon our system thus: "We men, who constantly carry the fragile machinery of our body about with us, must remember that every jolt that exceeds the ordinary limit can be fatal to us; that a slight shove accelerates the motion of the wheels, a stronger one arrests the motion, a gentle push drives us forward, a violent jerk throws us to the ground. For this reason the phenomena of fear, which in a small degree might be useful to us, become unhealthy and fatal to the organism as soon as they exceed certain limits: hence one must look upon fear as an illness."

He denies that the phenomena of fear, as trembling, scowling, the raising of hair and feathers, are essential to the survival of the fittest, and claims that the strong and healthy animals are those who do not fear, but concentrate all their powers to escape or defy the enemy. To the weak man a sudden danger brings fear; to the strong it is an incentive to action.

Fear, however, does not act upon the distribution of the blood and upon the respiration alone; but, since our body is a unit, it acts also upon the muscles,—those of the eye, the skin, the face, the digestive and secretory organs, as well as upon the larger muscles of motion. All this is of special interest (1) to the educator, the physician, and parent; (2) to the artist, the novelist, and poet. To the former Mosso's words are, "The first purpose of an education must be to increase man's strength, and to favor every thing that sustains life." Further, "One moment of violent fear causes far more dreadful effects and significantly severer injuries in woman than in man; but the fault is ours, who have always considered woman's weakness as a charm and an attraction; it is the fault of our educational system, that seeks to develop the emotional nature in woman, and, on the other hand, neglects that which would be more effectual,—to give her character. We imagine sometimes that the most important part of culture is that which education and study have given us; that the progress of mankind is accomplished entirely through the science, the literature, the works of art, which the generations have handed down to one another; but we carry a no less important part of the progress of culture with us in our blood. Civilization has reconstructed our nervous system; there is a culture that is transferred to the brains of the children by inheritance; the superiority of the present generation depends upon its greater ability to think and act. The future of a nation does not exist in its trade, its science, its army alone; but it exists in the bodies of its citizens, in the lap of its mothers, in the courageous or cowardly disposition of its sons."

To the latter he says, "When art extends its territory over all visible nature, it will find an incomparably greater number of powerful effects in the reproduction of pain than art possessed in classical times. The difficulties are certainly far greater here than in the dignified production of ideal beauty. And the painters and sculptors who undertake the great problem of reproducing pain will be obliged to equip themselves with a study of nature, and with anatomical and physiological knowledge to an extent for which, up to the Hellenic period, we have no example in art."

It is to illustrate the expressions of the face in suffering and fear in their wonderful variety, that the author reproduces, in two lithographic plates, a series of sixteen photographs taken of a boy while enduring an oft-repeated painful operation. They are worthy the study of psychologist and artist. The width of the horizon which art is to possess when incited by this new physiological knowledge is best indicated by his own words, which shall at the same time be the final ones of this article.

"I believe that with the progress in scientific criticism, together with an exact knowledge of physiology and the functions of the muscles, we shall come to the point where we can claim that the Greeks were not adequately prepared to represent the violent emotions effectively."

[1] Ueber den Kreislauf des Blutes im Menschlichen Gehirn (Leipzig, Veit u. Co., 1881); "La temperatura del cervello studiata in rapporto colla temperatura di altre parti del corpo," in the pamphlets of the R. Accademia dei Lincei (Rome, 1889); Sui movimenti idraulici dell' veide (K. medic. Akademie in Turin, 1875); Mosso et Pellaconi, Sulle funzioni della vescica (R. Accademia dei Lincei, Bd. XII., 1881; Archives italiennes de Bologne, 1882).

Economic and Social History of New England, 1620–1789. By WILLIAM B. WEEDEN. New York, Houghton, Mifflin, & Co. 2 vols. 8°. $4.50.

THIS is an elaborate and painstaking work, dealing with the whole subject of New England industry from the first settlements to the foundation of the present Federal Government. Beginning with the landing of the Colonists in the wilderness, the opening chapters are largely devoted to the subjects of agriculture, the distribution of land, and trade with the Indians. Ocean commerce and manufactures claim attention a little later, and soon become the most prominent parts of the subject. The social life of the Colonists is described with less fulness than the economic, but yet is never neglected. The whole subject of the book is treated by periods,—a method that has some advantages, and is to a certain extent necessary, but which has led to some repetition and diffuseness. The work is also encumbered with too much detail; the commercial and manufacturing operations, and even such matters as dress and equipage, being treated with a minute particularity which is wholly unnecessary, and wearisome to the reader. Facts in history are chiefly valuable as illustrating natural and moral laws, and in enabling us to mentally reconstruct the life of the past, and all details that are not needed for these purposes may better be dispensed with. Nor can we think Mr. Weeden altogether happy in his pictures of social life, his attention being too much fastened on the trifling matters of dress, manners, amusements, etc., and too little on the more important themes of morals and education. He gives a good deal of space to the sumptuary laws and other restrictive measures of the Puritans, but is not equally satisfactory in delineating the nobler elements of the Puritan character.

But though the book has in our eyes these defects, it is nevertheless a valuable work, and an addition to our historical and economical literature. It is written in a clear and simple style, which makes it at once more interesting and more easily understood than works of this kind often are. The author seems also to have taken great care in collecting his facts; town records, personal diaries, and merchants' accounts having been ransacked for the purpose, and often with good results. One of the strong points of the book is its treatment of political subjects in relation to economic life. The account of the settlement of the country and the beginnings of industry and commerce is one of the best parts of the work, and shows the working of both political and economical agencies in the formation of the new community. Again, in dealing with the navigation acts and other oppressive measures of the British Government, the author shows with much felicity their effect in injuring trade as well as in rousing the spirit of rebellion among the Colonists. Yet, though he has clearly grasped the economic bearings of political agencies, he has not allowed himself to be drawn off into political history itself, but has confined himself to his own proper theme. Mr. Weeden shows that the fisheries, in which the Massachusetts people always excelled, were the main foundation of New England commerce, agriculture being only a

means of subsistence, while beaver-skins, rum, and timber, all contributed to swell the merchants' cargoes. The rise and growth of manufactures receive due attention at all stages, and considerable space is devoted to the details of foreign trade. In the appendix there is a list of prices during each year of the period dealt with, while a very full index adds to the value of the book.

AMONG THE PUBLISHERS.

THE latest of the volumes treating of the "Famous Women of the French Court," translated from the French of Imbert de Saint-Armand by T. S. Perry, and issued by the Scribners, is entitled "Citizeness Bonaparte." It sketches the career of Josephine from the time of her marriage to the period of Napoleon's consulship, covering the most romantic and happy portion of her life; and includes the campaign in Italy, the expedition to Egypt, and Napoleon's subsequent personal success and triumph at Paris. The former volumes are entitled "The Wife of the First Consul," "The Happy Days of tho Empress Marie Louise," and "Marie Antoinette and the End of the Old Régime."

—*The Popular Science Monthly* for October will contain a further discussion of the fall of man and anthropology, by Dr. Andrew D. White, in which he reviews the futile efforts of Archbishop Whately and the Duke of Argyll to prove that the lowest races of men have sunk from an earlier civilization, and the equally successful attempts of certain church organizations in recent years to silence professors of science who were teaching the truths of evolution; a delightfully simple and practical talk to mothers about interesting children in the study of nature, by Mary Alling Aber, under the title "Mothers and Natural Science," in which the author points out the beneficial influence of scientific ideas on the formation of character, and tells how mothers may use the common things around them in teaching their children how to question Nature, and how to interpret her answers; "Liquor Laws not Sumptuary," by G. F. Magoun, D.D., being a reply to an article by Dr. William A. Hammond on sumptuary laws in an earlier number (Dr. Magoun quotes old colonial and recent State laws to show that existing statutes against the liquor traffic have not been made to enforce economy); and a copiously illustrated account of ancient dwellings of the Rio Verde valley, in Arizona, by Capt. Edgar A. Mearns, assistant surgeon, U.S.A., containing a description of ruined cliff-dwellings and pueblos explored by Dr. Mearns, with plans showing the exact arrangement of the rooms on the five floors of one of the former.

—Professor George T. Ladd of Yale University has just completed an important work entitled "Introduction to Philosophy,"—a broad and comprehensive view of the whole field of philosophy. It will be published by the Scribners, who also have in preparation an abridgment of Professor Ladd's "Physiological Psychology."

—On Oct. 1 The Open Court Publishing Company of Chicago will begin the publication of a new quarterly magazine of philosophy, science, religion, and sociology, *The Monist*. The first number of this new magazine will contain articles by Professor E. D. Cope of Philadelphia, Professor George J. Romanes of London, M. Alfred Binet of Paris, Professor Ernst Mach of Prague, Max Dessoir of Berlin, and Dr. Paul Carus of Chicago. The foreign correspondence and the departments for the general review of foreign philosophical and scientific literature will be conducted, for Italy, by Professor C. Lombroso, the criminologist; for France, by Lucien Arréat, the critic of the *Revue Philosophique;* for the northern countries, by Professor Harald Höffding of Copenhagen; for Germany, by Professor F. Jodl of Prague, and others. Reviews of American and English books will appear separately. Articles will appear in *The Monist* by Professor Joseph Le Conte, Professor William James, Charles S. Peirce, Professor Max Müller, Professor Ernst Haeckel, and Th. Ribot. The magazine will be

Publications received at Editor's Office, Sept. 8–13.

BARDEEN, C. R. Home Exercise for Health and Cure. Tr. from German of D. G. R. Schreber, M.D. 23d ed. Syracuse, N.Y., C. W. Bardeen. 91 p. 16°.
FISKE, J. Civil Government in the United States considered with some Reference to its Origins. Boston and New York, Houghton, Mifflin, & Co. 360 p. 12°. $1.
GALLAGHER, G. W. One Man's Struggle. New York and London, Funk & Wagnalls. 169 p. 12°. $1.
GUYOT, A. The Earth and Man. Tr. by C. C. Felton, LL.D. Revised ed. New York, Scribner. 334 p. 12°. $1.75.
HARKNESS, A. An Easy Method for Beginners in Latin. New York, Cincinnati, and Chicago, Amer. Book Co. 348 p. 12°.
HOUSE and Pet Dogs; their Selection, Care and Training. New York, Forest and Stream Publ. Co. 115 p. 16°. 50 cents.
MACFARLANE, J. An American Geological Railway Guide. 2d ed. New York, Appleton. 426 p. 8°. $2.50.
MARTYN, C. Wendell Phillips: the Agitator. With an Appendix containing three of the orator's masterpieces never before published in book form. New York and London, Funk & Wagnalls. 600 p. 12°. $1.50.
OSTWALD, W. Outlines of General Chemistry. Tr. by James Walker. London and New York, Macmillan. 396 p. 8°. $3.50.
PREBLE, H., and PARKER, C. P. Handbook of Latin Writing. Revised ed. Boston, Ginn. 109 p. 12°. 55 cents.
PRUDDEN, T. M. Dust and its Dangers. New York and London, Putnam. 111 p. 16°. 75 cents.
SIDNEY, Sir Philip. The Defense of Poesy: Otherwise known as An Apology for Poetry. Ed. by A. S Cook. Boston, Ginn. 143 p. 12°.
SMITH, C. E. The World Lighted, a Study of the Apocalypse. New York and London, Funk & Wagnalls. 218 p. 12°. 75 cents.
WEEDEN, W. B. Economic and Social History of New England, 1620–1789. 2 vols. Boston and New York, Houghton, Mifflin, & Co. 964 p. 8°. $4.50.
WOODY, S. E. The Essentials of Medical Chemistry and Urinalysis. 3d ed. Philadelphia, Penn., Blakiston. 157 p. 12°.
ZABRISKIE, F. N. Horace Greeley, the Editor. (American Orators and Reformers.) New York and London, Funk & Wagnalls. 398 p. 12°. $1.50.

devoted to the establishment and illustration of the principles of monism in philosophy, exact science, religion, and sociology. So far as the fulfilment of this aim will allow, it will bear a popular character, publishing articles of general interest as well as those of a more special character.

—*The Chautauquan* for October offers among its table of contents, "The Intellectual Development of the English," by Edward A. Freeman; "The English Constitution," by Woodrow Wilson, Ph.D., LL.D.; "How the Saxons Lived," by R. S. Dix; "The Tenure of Land in England," by D. McG. Means; "An Early Briton," by J. Franklin Jameson, Ph.D.; "Studies in Astronomy," by Garrett P. Serviss; and "Scientific Expeditions from American Colleges," by N. S. Shaler, S.D. In this number is begun the publication of a special English course of reading, to extend throughout the year. All the contributors are eminent authorities in their respective departments of investigation.

— Messrs. Ginn & Co. announce to be published about Oct. 1, "Handbook of Historic Schools of Painting," by Miss Deristhe L. Hoyt, instructor in the Massachusetts Normal Art School. This book, the outgrowth of many years of lectures, gives in a concise and systematic manner the most important facts regarding the principal schools of painting (both ancient and modern), the most noteworthy masters, and the most celebrated pictures. It contains also descriptions of the different kinds of painting most practised from the earliest times, definitions of technical terms, a list of emblems employed by the painters of the fifteenth, sixteenth, and seventeenth centuries to denote the different saints and other characters in their devotional pictures, with an explanation of their symbolic use of colors (essential to an understanding of their works), and a pronouncing vocabulary of the names of all artists mentioned. The book has long been needed, and will be found most helpful by art students, by reading-clubs, and by all interested in art or related subjects.

— Herbert Laws Webb, who will contribute an article on "Life on Board a Cable Ship" to the October *Scribner*, is a son of F. C. Webb, C.E., who, in company with Cyrus W. Field, selected the landing place at Valentia for the first Atlantic cable. The article is founded on Mr. Webb's experiences as a member of the technical staff of the Silvertown Telegraph Company's steamer, which laid the cable from Spain to the Canary Islands. John W. Root, who writes "The City House in the West" for the same number, is the architect of the great business block in Chicago known as "The Rookery." In his article Mr. Root says, "It may be prophesied with certainty, that, as a result of the architectural movement now in progress, Western cities like Chicago, St. Louis, Kansas City, Minneapolis, Milwaukee, and many others, will within a short time present streets unrivalled in the world for the variety, picturesqueness, and beauty of their domestic architecture." Many typical houses from these cities will appear in the illustrations. Mrs. Sylvanus Reed, for twenty-six years the head of a famous private school for girls in New York, says (in the October number), "I took the college system for men, and eliminated from it studies the educational value of which were questioned by high authorities, and adapted it to the needs of women. Just now, when in these colleges woman has demonstrated that she can do in an examination just as much and as well as a young man, the great universities of England and America have discovered, what a quarter of a century ago I believed to be the case, that much of this preparation is a waste of time and energy." Robert Brewster Stanton, chief engineer of the party which last winter made a perilous survey for a railway through the entire length of the cañons of the Colorado, will describe the adventures of that journey in an early number of *Scribner's Magazine*. No party has ever before traversed these cañons except that of Major J. W. Powell in 1869, and Mr. Stanton's expedition is the first that has ever made a continuous trip along the waters of this river from its head to its mouth.

A lady in Columbia, S.C., who reared silkworms, being unable to obtain the leaves of the mulberry or Osage orange, made use of the leaves of the rhea-plant, which were eaten ravenously by the worms. When sent to Philadelphia, the cocoons were stated to be larger, and the silk finer, than was the case with those of worms fed on mulberry and Osage orange leaves.

CATARRH.

Catarrhal Deafness—Hay Fever.

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Sufferers are not generally aware that these diseases are contagious, or that they are due to the presence of living parasites in the lining membrane of the nose and eustachian tubes. Microscopic research, however, has proved this to be a fact, and the result of this discovery is that a simple remedy has been formulated whereby catarrh, catarrhal deafness and hay fever are permanently cured in from one to three simple applications made at home by the patient once in two weeks.

N.B.—This treatment is not a snuff or an ointment; both have been discarded by reputable physicians as injurious. A pamphlet explaining this new treatment is sent free on receipt of stamp to pay postage, by A. H. Dixon & Son, 337 and 339 West King Street. Toronto, Canada.—*Christian Advocate.*

Sufferers from Catarrhal troubles should carefully read the above.

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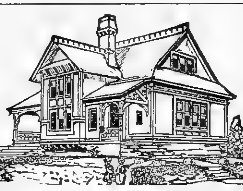

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KOCH ON BACTERIOLOGY.

THE *Lancet* of Aug. 16, 1890, gives a summary of the address of Koch at the Tenth International Medical Congress, in which he declared that he had not much that was new to tell, but he would make a preliminary communication regarding the result of important new experiments. This communication, a *résumé* of which is published in the *Medical and Surgical Reporter*, had reference to a remedy for consumption discovered by him, which, however, he would not name till his experiments were ended. The rest of his address was an admirably clear account of the progress of bacteriological research.

Only fifteen years ago one regarded the micro-organisms occasionally observed in the bodies of diseased animals and persons more as curiosities than as things essentially connected with the disease; and, considering the great ignorance of their nature which then prevailed, this could not but be so. There were investigators, for instance, who declared bacteria to be crystalloid bodies, not living organisms. With the perfecting of the magnifying instruments, the application of staining, the propagation of organisms on nutritive media, culminating soon in pure cultivation, a rapid change took place. It became possible to distinguish a number of quite definite sorts with certainty, and to ascertain that they were distinctly connected with the diseases in which they were found. It was further ascertained that one sort of bacteria was not transformed into another; and the remarks of old writers on leprosy and consumption, for instance, even justified the conclusion, that just as certain diseases, presumably caused by micro-organisms, had remained unchanged, their germs also must, on the whole, have retained their old qualities. Within certain limits, indeed, deviations of demeanor had been observed in some bacteria, but that was the case among the higher plants too, without the varieties ceasing to belong to the species. The main gain of this period of research was the recognition of the fact that the thing was to discover as many morphological and biological qualities of a bacterium as possible, so as to be guarded against the danger of confounding various bacteria. There was still a danger of this with certain bacteria.—the typhus and diphtheria bacilli, for example,—whereas it had been removed in the case of the tubercle and cholera bacilli by the very exact investigations of these organisms. In their case too, however, the bacillus must never be determined by one mark alone. He had experienced this in his own case, having for some time taken the bacillus of chicken cholera—for the special study of which he had not had material—for a variety of the bacillus of Asiatic cholera, till a new series of experiments had convinced him of his error. Whether the germ of chicken cholera would have an injurious effect on human beings was still a question, and a question that would not easily be answered, as one could not well make direct experiments on human beings, but must wait to see whether the bacillus of chicken cholera would not one day appear in a human cholera patient.

As to the etiological connection of the noxious bacteria with infectious diseases, general opinion was at first against it, and strict proof was necessary. It was necessary to prove in all cases that the disease and the micro-organism always appear together; that the micro-organism in question does not appear in any other disease; and that the micro organism, propagated outside of the body through several generations, always produces the same disease if it gets into the body again. Now that the etiological connection had been proved in this manner in anthrax, tuberculosis, and erysipelas, and the resistance of opponents broken, one might confine one's self in further cases to the two first lines of proof. This proof had still to be given in the case of abdominal typhus, ague, leprosy, diphtheria, and Asiatic cholera; but in the case of the latter it was already generally assumed that the cholera bacillus was the cause of cholera. As subjects of investigation for the immediate future, Koch designated the question whether the pathogenic bacteria live only in the body, or outside of it too, and in the latter case only occasionally get into the body and cause disease; also the manner of getting into the body and their demeanor there.

The next advance in bacteriology was the discovery of the poisons excreted by the bacteria, which were now regarded as the cause of death in fatal bacterial diseases, for the opinion that the white blood-corpuscles resist the bacteria was more and more losing ground. Koch then discussed the spore-formation of some bacteria, and the influences of air, warmth, moisture, and chemicals on bacteria. Direct sunlight quickly killed bacteria; the tubercle bacillus, for instance. Even daylight produces the same effect, though more slowly. Cultivations of the tubercle bacillus, propagated for from five to seven days at a window, died. Moisture was necessary for the growth of bacteria; moisture, however, on the other hand, hindered their spreading. A bacterium never rose: its transmission took place only by the flying of dust, if it remained for some time capable of life in dry air. By means of improved staining methods some knowledge of the inner structure of bacteria had recently been gained. There seemed to be an inner nucleus of plasma with flagella proceeding from it. In certain infectious diseases—measles, scarlet-fever, and small-pox, for instance—the presence of a pathogenic bacterium had not yet been proved. In hydrophobia, influenza, whooping-cough, trachoma, yellow-fever, cattle-plague, and pleuro-pneumonia of cattle, also, no specific bacterium had been discovered, though the infectious nature of these diseases was evident. And perhaps these diseases were caused, not by bacteria, but by organic parasites belonging to quite another group of animated beings. In the blood of malaria patients protozoa had been found, which were now suspected of causing this and other infectious diseases. Whether protozoa, the lowest representatives of the animal world, really deserved this suspicion, would have to be decided by a method analogous to bacteriological pure cultivation.

But now there remained the question as to what had been the practical utility of all these extremely laborious investigations. The investigator, indeed, ought not to inquire after the immediate practical utility of his work. In the present case, however, the question was not entirely devoid of justification. Nor was it quite impossible to give it a satisfactory answer. Had not bacteriological investigation alone led to effective methods of disinfection? The value of water-filtration, the question of the filtering qualities of the soil, of the fitness of surface water for use as drinking-water, of the best method of constructing wells, the sterilization of milk (so important especially for the nutrition of infants), the investigation of the air in schoolrooms and in sewers, the proof of the presence of pathogenic bacteria in the soil and in the air, were all bacteriological questions or conquests.

The diagnosis of isolated cases of Asiatic cholera rendered

timely preventive measures, the discovery of tubercle bacilli rendered timely therapeutic measures, possible. Besides these, indeed, only Pasteur's inoculations against hydrophobia, anthrax, symptomatic anthrax, and swine erysipelas, remained to be mentioned; and the first of these probably did not belong to bacteriology at all, though they had grown on its soil. "But," concluded Professor Koch, "it will not always remain so. Therapeutics proper will also derive benefit from bacteriology; hardly, indeed, for diseases of rapid course, in which prevention will remain the main thing, but certainly for slow diseases, such as tuberculosis. Others also, like Billroth, maintain this hope; but the mistake has frequently been committed of beginning the experiment on human subjects. I regard this as wrong, and look upon the alleged successes of various remedies, from benzoate of soda to hot air, as illusory. For years past I have been seeking means for the therapeutic treatment of consumption, but I began with the pure cultivation of the bacillus. I found a number of substances,—ethereal oils, tar-pigments, mercurial vapor, salts of gold and silver, especially cyanide of gold, for instance,—some of which, like the last, even when very strongly diluted, prevent the growth of the bacillus, which, of course, suffices to bring the disease to a standstill. All these substances, however, have proved ineffectual when used against the bacillus in the bodies of animals. I continued my search, however, and found what I sought. Susceptible as the guinea-pig is to the tubercle bacillus, it proved non-inoculable when treated with the substances in question, and even when its disease was far advanced it could be brought to a standstill by this means. This fact may give occasion to search for similar effective remedies in other infectious diseases also, and here lies the field for an international contest of the highest and noblest kind."

EXCAVATIONS IN JUDÆA.[1]

THE traveller from Hebron to Gaza cannot fail to be struck with the sudden contrast presented by the mountainous country that he leaves behind him, and the long stretch of almost level plain into which he descends. After passing Bêt-Jibrîn, in which some scholars would see the sight of the ancient Gath, he has to wend his way through narrow defiles and precipitous limestone crags until he suddenly finds himself in the rich plain which forms the *Negeb*, or district of "southern" Judæa. On the first occasion on which I traversed it, however, it was not the sharp contrast between mountain and plain that first attracted my attention: it was rather the number of *tels*, or artificial mounds, with which the plain is covered. Each *tel* marks the site of an ancient city or village; and no archæologist could help reflecting, as he gazed upon them, what a rich field must here await the future excavator. Among them I noted two or three of remarkable height and size, and longed for an opportunity of discovering the historical secrets that lay hidden within them. It was more especially on a lofty mound, which my dragoman told me was called Tel 'Ajlân, that I cast covetous eyes.

The curiosity which the site of the mound excited has now been partially gratified. After ten years of patient importunity, the Palestine Exploration Fund succeeded last spring in obtaining permission from the Turkish Government to excavate in the south of Palestine; and Mr. Flinders Petrie, the prince of living excavators, placed his services at the disposal of the fund. In spite of obstacles of every nature, presented by the climate, by Turkish officialism, and by the character of the Bedouin inhabitants of the country, his few weeks of work have produced truly marvellous results. We now know something of the art and building of the Israelites in the period of the Kings, and even of that older Amorite population whom the Israelites conquered. It has become possible to speak of Palestinian archæology, and to determine the age of the pottery and hewn stones which are met with in the country. Where all before was chaos, order at last has begun to reign.

The firman granted by the Porte allowed excavations to be conducted over an area of 9½ square kilometres in the neighborhood of Khurbet 'Ajlân, but enjoined that all objects found, including even duplicates, should be handed over to a Turkish commissioner specially appointed to oversee the work. When, however, Mr. Petrie arrived in Jerusalem at the beginning of March, he found, that, owing to a trifling error of description, the firman was detained in Constantinople; and it did not reach Jerusalem, where Mr. Petrie was awaiting it in the midst of violent storms and penetrating cold, until the very end of the month. At last it came, but, in spite of the courtesy and assistance of the enlightened Pacha of Jerusalem, further delays were interposed by the Turkish commissioner; and it was not until April 14 that work could be commenced, one week only before Ramadan. What Ramadan means is known too well to those who have lived in the Mohammedan East. An unbroken fast throughout the day, followed by feasting at night, renders even the most industrious disinclined for work. And Mr. Petrie had to deal with a population naturally disposed to steal rather than to work, and who had never tried their hands at excavating before. It was no wonder that the excavator from time to time thought regretfully of the industrious and intelligent *fellahin* he had left behind in Egypt, and longed to see the "savages" who now squat on the fertile plain of Judæa swept back into their ancestral desert homes.

Mr. Petrie began with some preparatory digging at a place known to the geographers as Umm el-Laqîs, which has been supposed to be the site of the once important fortress of Lachish. The first time I visited the spot I was told that the real name of the hill-slope was Umm el-Latîs; and three years ago, when I visited it for a second time, I satisfied myself that it represented nothing more than the site of a village of the Roman age. Mr. Petrie's excavations have abundantly confirmed my conclusion. The site, he found, was covered with only six to eight feet of artificial earth, which was filled with fragments of Roman pottery, and in one place a worn coin of Maximian Hercules was disinterred two feet above the virgin soil. Accordingly, he soon moved with his workmen to the *tel*, which formed the most prominent object in the district where he was permitted to dig.

The *tel* is about six miles from the village of Burêr, and near the site of a Roman hamlet which goes by the name of Khurbet 'Ajlân, or "Ruin of Eglon." It proves not to be called Tel el-'Ajlân, "the mound of the Eglonite," as my dragoman informed me, but Tel el-Hesy, apparently from a spring of water which flows past the eastern face of the mound. The spring is the only source of fresh water that exists for many miles around, and falls into a brackish brook which trickles from the neighboring Tel en-Nejîleh, the united stream being subsequently swallowed up in a stony *wadi* a few hundred yards lower down. Mr. Petrie is doubtless right in thinking that it was to this spring that the city now represented by the Tel el-Hesy owed its importance. The spring would have borne the same relation to the old town that the spring of the Virgin bore, and still bears, to Jerusalem. When swollen by rain, the stream is capable of doing a considerable amount of mischief. It has washed away a large portion of the eastern and south-eastern sides of the mound, thus laying bare a section of the *tel* from its top to the bottom. This has proved, however, of invaluable service to the explorer, as the time at his disposal would never have allowed him to uncover a tenth part of the soil which has been removed by the water. Another season of work would have been needed before the lowest part of the *tel* could have been reached, and the history of the mound revealed, together with that of the pottery which is embedded in it. The kindly assistance of the water was the one piece of good fortune that fell to Mr. Petrie's lot, and he knew how to make the most of it.

On the southern and western sides of the *tel* is an enclosure, about thirty acres square, which is surrounded by a "clay rampart" still seven feet high in certain parts, and in one place by a brick wall. As there is but a slight deposit of earth within the enclosure, while nothing was found in it, Mr. Petrie is doubtless right in holding that it was intended to shelter cattle in case of an invasion. It probably belongs to the later period of the city to which it was attached.

The city is represented by the *tel* or mound. This rises to a height of no less than sixty feet, formed by the accumulated ruins of successive towns, the lowest of which stood on a platform of

[1] Article by A. H. Sayce, in The Contemporary Review for September.

natural soil about fifty feet above the stream which runs through the *wadi* below. The mound is about two hundred feet square.

Mr. Petrie's description of it reads like the record of Dr. Schliemann's discoveries at Troy. City has been piled upon city, the latest colonists being Greeks, whose settlement was itself swept away before the age of Alexander the Great. The lowest and earliest city was the most important, if we may judge from the size of the wall with which it was encircled. This was 28 feet 8 inches thick, and was formed, like the walls of an Egyptian city, of clay bricks baked in the sun. It had been twice repaired in the course of its history, and it still stands to a height of twenty-one feet. As thin black Phœnician pottery was found above it, which Egyptian excavation has shown to be not later than about B.C. 1100, we may follow Mr. Petrie in regarding the wall as that of one of those Amorite cities which, as we are told, were "walled up to heaven" (Deut. i. 28). It is the first authentic memorial of the ancient Canaanitish population which has been discovered in Palestine. As large quantities of potsherds have been met with both outside and within it, we now know the precise characteristics of Amorite pottery, and can consequently tell the age of a site on which it occurs.

The city to which the wall belonged was taken and destroyed, and the wall itself was allowed to fall into ruin. Then came a period when the site was occupied by rude herdsmen or squatters, unskilled in the arts either of making bricks or of fortifying towns. Their huts were built of mud and rolled stones from the *wadi* below, and resembled the wretched "shanties" of the half-savage Bedouin, which we may still see on the outskirts of the Holy Land. They must have been inhabited by members of the invading Israelitish tribes who had overthrown the civilization that had long existed in the cities of Canaan, and were still in a condition of nomadic barbarism. We may gather from the Book of Judges that the period was brought to an end by the organizing efforts of Samuel and the defeat of the Philistines by Saul. With the foundation of the Israelitish monarchy came a new epoch of prosperity and culture. Jerusalem and other cities were enlarged and fortified (1 Kings ix. 15–19), and the Chronicler tells us (2 Chron. xi. 5) that after the revolt of the Ten Tribes the chief cities of Judah were further strengthened by Rehoboam. The ruins of Tel el-Hesy furnish numerous evidences of this new epoch of building. First of all, we have a wall of crude brick thirteen feet thick, which is probably identical with a wall traced by Mr Petrie along the western and northern faces of the *tel*, where it ends in a tower at the north-west corner. However this may be, the section laid bare by the stream on the eastern face of the *tel* shows that the thirteen-foot wall was repaired and rebuilt three or four times over. All these rebuildings must be referred to the age of the Kings, since the only remains of post-exilic times discovered on the mound are those of the Greek settlement of the fifth century B.C.

One of the later rebuildings is illustrated by a massive brick wall twenty-five feet thick, and of considerable height, which Mr. Petrie has discovered on the southern slope of the *tel*, and which he refers to the reign of Manasseh. It has been built above a *glacis* formed of large blocks of stone, the faces of which were covered with plaster. Mr. Petrie has traced the *glacis* to a height of forty feet, and has found that it was approached by a flight of steps, at the foot of which, in the valley, was a fortified building, of which only the gateway now remains. The earth on which the *glacis* rests is piled ten feet deep around a large building eighty-five feet in length, and composed of crude brick walls more than four feet in thickness. Ten feet below the building are the ruins of another large building, which, after having been burned, was rudely put together again out of the old materials. The original edifice was of crude brick, with doorways of "fine white limestone." Several slabs of the latter have been discovered. On three of them is "a curious form of decoration by a shallow pilaster, with very sloping side, resting on a low cushion base, and with a volute at the top." As Mr. Petrie remarks, "we are here face to face at last with work of the earlier Jewish kings, probably executed by the same school of masons who built and adorned the Temple of Solomon." In the volute Mr. Petrie sees a representation of a ram's horn, and calls to mind the biblical expression, "the horns of the altar." Whether this be so or not the volute is an earlier form of that which characterizes the Ionic capital. On one of the slabs is a *graffito*, which must have been scratched upon the stone by one of the subjects of Solomon or his immediate successors It represents a lion or dog walking; and, as the slab was built into the reconstructed edifice upside down, the drawing must have been made while the stone still formed part of the original edifice. This can hardly have been erected at a later date than the reign of Rehoboam.

The stones of the *glacis* have led Mr. Petrie to a very important conclusion. They are draughted, the surface of the stone being smoothed away towards the edges so as to leave a rough projection in the middle. But they show no trace of the claw-tool, or comb-pick, as Mr. Petrie prefers to call it. Now, this tool is characteristic of Greek work; and as it was used in Greece in the pre-Persian era, while it was introduced into Egypt only after the contact of Egypt with Greece, we may infer that it was of Greek invention. Its employment in Palestine, therefore, would imply that any building in which it was used belonged to the Greek age, Mr. Petrie's excavations at Tel el-Hesy having shown that older Jewish work exhibits no traces of it: consequently the dispute as to the age of the Harâm wall at Jerusalem is at last settled. Here the stones have been dressed with a claw-tool from the foundation upwards, and it becomes clear, accordingly, that they must all be referred to an Herodian date. I have always felt doubtful about the antiquity commonly ascribed to them on the strength of certain masons' marks pronounced by Mr. Deutsch to be early Phœnician characters. But it is questionable whether they are characters at all: at any rate, they do not belong to an early form of the Phœnician alphabet, and no argument can be drawn from them as to the pre-exilic origin of the monument on which they occur.

But while the date of the great wall which surrounds the Mosque of Omar at Jerusalem is thus brought down to the classical period, the very fact which has reduced its claims to antiquity has served to establish the pre-exilic character of another monument near Hebron. This is the Râmet-el-Khalîl, or "Shrine of Abraham," about three miles to the north of Hebron. The huge blocks of stone of which this building was composed have never been touched by the claw-tool, and we may therefore see in them the relics of a temple the foundation of which must be older than the exile. Can it represent the site of Kirjath-sepher, the Canaanite "city of books"?

In Tel el-Hesy Mr. Petrie sees the ruins of Lachish.[1] The spring which flowed beneath its walls is, as has been said, the only fountain of fresh water which gushes from the soil for many miles around; and the spot would naturally, therefore, have been selected as the site of an important fortress. How precious such a supply of water would be may be judged from the fact that the brackish stream which flows from the smaller and more insignificant Tel en-Nejîleh was in ancient times confined there by a massive dam. We know that Lachish was one of the chief fortresses of Judæa, and its capture by Sennacherib was considered sufficiently memorable to be depicted in a bas-relief on the walls of that monarch's palace; we know also that it stood somewhere in the neighborhood of the present Tel el-Hesy. On the other hand, the name of Khurbet 'Ajlân, given to an adjoining site, might incline us to believe that the *tel* represents Eglon rather than Lachish. Eglon and Lachish, however, were close to one another, and, considering that Lachish was the larger and more important town of the two, Mr. Petrie is probably right in locating it at Tel el Hesy. In that case Tel en-Nejîleh will be Eglon.

If Tel el-Hesy is Lachish, the monuments of sculpture and inscription overthrown there by Sennacherib must still be lying within its ruins. Indeed, even more precious relics of the past may await the explorer of the old Amorite city. Among the tablets discovered at Tel el-Amarna are despatches to the Egyptian king from Zimridi and Yabniel, the governors of Lachish, which prove that the art of writing the Babylonian language in cuneiform characters upon clay was known and practised there. The city was the seat of a governor, and it is reasonable to suppose

[1] Major Conder had already suggested the same identification (Memoirs of the Survey of Western Palestine, iii. p. 261).

that the governor's palace contained an archive chamber. For aught we know, the clay tablets with which the archive chamber was once stored may still lie buried under the *débris* which has concealed the ruins of the Amorite city for so many generations from the eyes and ravages of man.

However this may be, Mr. Petrie's excavations, brief and imperfect as they have necessarily been, have taught us two important facts. The first of these facts is the mutability of local nomenclature in the East. The recurrence of an ancient name in the mouths of the modern inhabitants of Palestine by no means implies that the place to which it is given is the representative of an ancient locality of the same name. The utmost it can prove is that the ancient site is probably to be sought in the near neighborhood of the spot to which the name is now applied. The existence of a name like Khurbet 'Ajlân, given though it may be to a comparatively recent site, may yet show that the Eglon of the past once stood somewhere in its vicinity. But it can do no more. The tides of war which have swept from time to time over the civilized East have displaced the older population, have reduced the earlier cities of the land to "ruinous heaps," and have transferred their inhabitants to other places. When the Jews returned from the Babylonian exile, they were in most cases likely to settle in the open country, at a distance from the barren mounds which were all that remained of the older cities. The new Eglon would arise, not on the site of the more ancient one, but where the settlers would be surrounded by green pastures or cultivated fields. The fact is a warning to those who would place the ancient Megiddo at Mujedda on the evidence only of a similarity of name, or who would transform the "Stone" of Zoheleth into the Cliff of Zehwele, in defiance of philology and geography.

The second fact brought to light by Mr. Petrie is, that, if we are ever to learn any thing about pre-exilic Israel on the soil of Palestine itself, it must be by the help of the spade. His excavations have shown that up to now we have known nothing, or next to nothing, of the archæology of the Holy Land before the classical age. They have further shown what a rich harvest, on the other hand, awaits the excavator. Already the basis has been laid for a scientific study of Palestinian antiquities; the sites that cover the ground can now be assigned to their respective ages by means of the pottery they contain; and we can tell from a simple inspection of the stones of a building whether or not it belongs to the pre-exilic epoch. The future excavator will no longer set to work in the dark, trusting for success to chance and luck: he will know beforehand where and how to dig, and with what rewards he is likely to meet. The explorer who will devote himself to the labor, as Sir A. H. Layard devoted himself to Nineveh and Dr. Schliemann to Troy, will obtain results as marvellous and far-reaching as those obtained by Layard and Schliemann. The former story of Palestine has not been obliterated from its soil, as has often been imagined: on the contrary, it is indelibly impressed on the stone and clay which that soil still holds in its bosom. We have dug up Homer and Herodotus: we shall yet dig up the Bible.

Mr. Petrie's excavations could not be continued long enough to allow him to penetrate to that central core of the *tel* where alone he could expect to meet with inscribed stones. Apart from stonemasons' marks, in the shape of early forms of Phœnician letters, the only inscription he has disinterred is scratched on the fragment of a terra cotta vase. The inscription he assigns to the age of Hezekiah. One of the letters composing it, however, has a very archaic form, and it may therefore belong to an earlier period. But, like the famous Siloam inscription, it indicates in a curious way what was the ordinary writing-material employed by the Jews. The "tails" of certain letters are curved, the curve being represented on the refractory terra cotta by two scratches, which together form an angle. It is clear from this that the Hebrews must have ordinarily written on papyrus or parchment, where the longer lines of the characters would naturally run into curves, and not, like the Moabites, for instance, on clay, stone, or metal. They were a literary rather than a monumental people.

A seal found in Jerusalem, and belonging to Mr. Clark, has at last given us a clew to the relative age of the few Jewish inscriptions of the pre exilic period which are at present known to us. The inscription upon it states that it was the property of "Elishama', the son of the King." Now, we hear about this Elishama' from the prophet Jeremiah (xli. 1), who tells us that he was of "the seed royal," and the grandfather of Ishmael, the contemporary of Zedekiah. Elishama', accordingly, will have flourished about B.C. 650, and we can therefore now determine what were the forms taken by the letters of the Jewish alphabet at that particular time. Comparing them with the forms of the letters in the Siloam inscription, we find that the latter must be somewhat, though not greatly, older, and that consequently the general opinion is justified which considers that the construction of the tunnel commemorated by the inscription was a work of Ahaz or Hezekiah. A fixed point of departure has thus been obtained in Hebrew epigraphy.

The excavator, then, who continues Mr. Petrie's work next season will be equipped with knowledge and resources which, only six months ago, were not even dreamed of. Discoveries of the highest interest await him,—monuments of David and Solomon and their successors; it may be even the clay records of the Amorite priests and chieftains whom the children of Israel dispossessed. The bearing such discoveries may have upon the interpretation and criticism of the Old Testament Scriptures, the light they may throw upon the conquest of Canaan or the establishment of the Davidic monarchy, cannot even be conceived; but we may feel sure that such discoveries will be achieved, if only the means of achieving them are provided: and provided we cannot doubt they will be, as soon as the results of Mr. Petrie's preliminary campaign are made known to scholars and lovers of the Bible. In wealthy England the Palestine Exploration Fund cannot fail to find that money for the work will flow to it in abundance.

SUGAR AND THE SUGAR-CANE IN CUBA.

M. TROY, French consul at Santiago de Cuba, says, according to the *Journal of the Society of Arts*, London, that the cultivation of the sugar-cane in the eastern portion of the Island of Cuba is almost entirely confined to the districts of Santiago, Guantanamo, and Manzanillo. This cultivation, although it has experienced some extension of late years, is not in the flourishing condition it was twenty years ago. This falling-off is due to the civil war, which ruined many planters and discouraged others. The profits, however, realized for some time past by those planters who had sufficient credit, or confidence in the future, to continue to engage in this industry, have given a stimulus to the cultivation of the cane. Sugar-factories have been established in many parts, particularly in the district of Guantanamo and Manzanillo; old sugar-factories have been supplied with fresh plant; and many planters, encouraged by the high prices recently realized, have hastened to get their ground ready for cultivation. Part of the products of the province of Santiago is shippped to Spain, and some small quantity is consigned each year to Canada; but the United States absorbs almost the whole of the yield of the island. The Cuba market was some years ago controlled by French merchants, who owned the greater part of the sugar-factories of the province; but since the civil war many planters sold their estates, and retired to France. A few estates, however, are still owned by Frenchmen, at Guantanamo especially. Those known as Sainte Marie, Sainte Cecile, and San Antonio are directed or owned by Frenchmen. All the land in the island is, in general, fit for the cultivation of the cane, an even surface being generally chosen with a view to facilitate the working and the harvesting. The ground should also be as near the sea as possible, so as to avoid the cost of carriage and transport, which is particularly high in that part of the island, where it may be said there is an absence of railroads, and the carriage roads are in a deplorable condition. If the ground chosen is one that has hitherto been uncultivated, the planter, first of all, clears it in cutting down the branches of the trees and small shrubs with the *machete*, and burning the larger trees. The expenses of these preliminary operations may be estimated at from four hundred to five hundred dollars per plantation of thirteen hectares (the hectare is equivalent to 2.47 acres). Holes are then dug at intervals of from three to four feet, and in them are placed hori-

zontally pieces of cane of a length from two to three joints. If the ground has previously been under cultivation, the methods differ. The ground must first of all be ploughed, and furrows are then made in which entire canes are stretched *á chorros;* that is to say, end to end horizontally. The plants are then covered with earth. The sugar-cane is frequently planted in the spring, but many planters are of opinion that plantations in Cuba sown in winter give a much better yield. The young plants are allowed to shoot for ten or eleven months if they have been planted in the spring, for fourteen or sixteen months if planted in the winter, and the harvest then takes place. There are in the island several varieties of sugar-cane,—the white or Otaheite cane, the twisted white cane, the twisted violet cane, and the so-called black cane. The first two varieties are the only ones cultivated at Cuba. The white cane is prepared for planting in virgin soil, and gives a good yield. The crystalline is reserved for old plantations: it is better adapted to resist the long drought than the white variety. The cultivation of the last three species of sugar-canes has been abandoned on account of their insufficient yield. Before the abolition of slavery, the planters themselves cultivated their fields; since that period, however, they have experienced the greatest difficulty in obtaining a sufficient number of hands to harvest their canes. Many planters, in consequence, deemed it advisable to divide their labor between a certain number of colonists, who are bound to cultivate each his plot of ground, to plant the canes, to cut them at harvest time, and to carry them to the factory, where they receive, after the sugar is turned out, a certain proportion of the quantity of the sugar extracted from the canes harvested on their allotments. Cuban sugar is generally prepared for export. The special quality intended for home consumption is clearer and finer than that shipped abroad.

THE UNIT MEASURE OF TIME.[1]

I DESIRE at the opening meeting of this section of the Royal Society to bring to your attention a subject of some general importance.

For a number of years past attempts have been made on both sides of the Atlantic to effect a reform in the method of reckoning time. The degree of success which has attended the movement is a matter of surprise when we consider that the changes involve a departure from the usages of society, and are in opposition to the customs of many centuries.

The modern introduction of rapid means of communication has created conditions of life different from those of preceding generations. It may be said that until a few years back, localities separated by a few miles of longitude were assumed to have distinct and separate notations of time. When many localities were first brought into close relations by the establishment of a line of railway, the different local times (so called) with which the railway authorities had to deal produced much confusion. In order to attain security for life and property in operating the line, and likewise to promote the convenience of the public using it, it became necessary to observe a uniform notation, which received the name of "railway time;" that is to say, the many local reckonings which prevailed at the numerous points between the two termini were reduced to a single reckoning common to the many localities.

As lines of railway multiplied, the unification of the reckoning of time became more indispensable, and it early came to be seen that the benefits to result from unification would be in proportion to the extent of territory embraced within its operations. At length it became obvious that uniformity of reckoning might with advantage be extended to a whole continent or the whole globe. Investigation also established that such an extension would contravene no law of nature, or principle of science.

The proposal to supersede the numberless local times by a single notation, synchronous in every longitude, had a somewhat Utopian aspect. Many, indeed, regarded it as a revolutionary innovation, for it came into direct conflict with the customs and the habits of thought which had descended from a remote antiquity. Nevertheless, the potent agencies steam and electricity, which have co-operated in making astonishing transmutations in human affairs, have forced on our attention the investigation of time and its notation, and demanded some change to meet the altered circumstances of daily life.

If we consider the nature and attributes of that which we know as time, we will find that it is wholly independent of material bodies, and uninfluenced by space or distance; that it is essentially non-local and an absolute unity; that it is not possible for two times to co-exist, or for time to be divided into two parts having a separate entity, in the sense that material things can be divided. This view of time incontrovertibly established, there is no ground for the theory that there are many local times. We may therefore sweep away the ordinary usages based on that theory as being unsound and untenable, and the way is made clear for a comprehensive system of time-reckoning to embrace the whole globe.

About fourteen years ago the effort was first made to introduce a reform which would satisfy the requirements of the age. Whatever system might be adopted, it was felt that it should be based on the fundamental principle that there is only one time. It was, moreover, held to be expedient that there should be only one reckoning of time common to all nations; and, to secure a common reckoning, one established zero and one common unit of measurement became necessary.

With the attainment of these objects in view, preliminary discussions took place at the meetings of several scientific associations in Europe and America, and it was held that in a matter of such widespread importance the unit of time should be a measure which could be readily referred to as a perpetual standard for the use of the entire human family. It was likewise felt desirable, if not indispensable, that all nations should acquiesce in its recognition.

It was accordingly proposed at an international geographical congress at Venice in 1881, and confirmed at a geodetic congress at Rome held two years later, that the government of the United States should be invited formally to call a conference of representatives, to be specially appointed by the governments of all civilized nations, to consider the subject, and determine the zero and standard of reckoning to be used in common throughout the globe.

Six years ago this conference assembled, under the auspices of the United States, in the city of Washington, the governments of twenty-six nations sending fully accredited delegates. Their deliberations extended over the month of October, 1884. With substantial unanimity they passed a series of resolutions, in which the unit of measurement was constituted, and they recommended that time be computed according to the solar passage on a recognized zero meridian of the earth's surface.

The resolutions of the Washington conference thus authoritatively established the fundamental principles which underlie the scheme for a general unity of time-reckoning; each nation being left in its discretion to accept the details of the reform whenever deemed expedient in each individual case. To facilitate the acceptance of the new system, the circumference of the globe has been divided into twenty-four sections, the reckoning in each section being based on a standard subsidiary to, but directly related to, the unit measure. In the twenty-four subsidiary standards thus constituted the hours are simultaneous, although differently numbered in accordance with the longitude of the several sections. With the single exception respecting the numbers by which the hours are locally to be known, there is complete identity in every subdivision of time throughout the twenty-four sections. The many local days which follow in succession during each diurnal period are by this arrangement reduced to twenty-four normal days, each differing an hour in its commencement from the day which it succeeds. Twelve of these normal days precede, and twelve follow, the primary standard or unit measure of time, which is the mean of the whole series of normal days. By this expedient, which has received the name of "the standard time system," the means have been provided by which all nations, without any apparent great departure from old usages, may observe substantially the one common reckoning.

[1] Address at the opening of Section III. of the Royal Society of Canada, by the president, Dr. Sandford Fleming, May 27, 1890.

The adoption of the system of standard time has already made considerable progress. In North America, standard time was first introduced in railway economy: it has since been generally accepted by the mass of the community. In Asia the same system has been legally established throughout the Japanese Empire. In Europe a general interest has been awakened on the subject; and at the present moment it attracts special attention in Austria-Hungary, Germany, and Belgium. Late advices give expression to the belief that standard time will be adopted by the railway service of these countries before many months. It is already observed in Sweden and Great Britain.

Thus, at the present day, standard time has been fully accepted in Asia by not less than forty millions of people, in Europe by almost an equal number, in America by more than sixty millions; and there is scarcely a doubt that in no long period it will be in use throughout the greater part of central Europe, making a total number of probably two hundred and thirty millions of the most progressive peoples in the three continents who will have accepted the principles of reckoning based on a common unit. Without taking into account central Europe, where the reform is on the eve of adoption, the unification of time-reckoning has so far advanced, that in Japan, Belgium, Sweden, England, Scotland, Canada, and the United States, all well regulated clocks strike the hours at the same moment (although locally the hours are distinguished by different numbers), and the minutes and seconds in all these countries are absolutely synchronous.

The unit of measurement authoritatively established by the resolutions of the international conference of 1884 is the basis of the system by which these results have been obtained; and we must regard this new system as the one which shall hereafter be observed by the great mass of the civilized inhabitants of the world in their daily reckonings and in their chronology. It is of first importance, therefore, that no doubt or ambiguity should exist in connection with it. By the resolutions of the conference of 1884, the unit measure may be defined as the interval of duration extending from one mean solar passage on the anti-meridian of Greenwich to the next succeeding passage. This standard unit has been variously designated as follows; viz., 1. A Universal Day, 2. A Terrestrial Day, 3. A Non-Local Day, 4. A Cosmopolitan Day, 5. A World Day, 6. A Cosmic Day.

It requires no argument to show that no one of these six terms is appropriate. The unit of time is not a day in the ordinary sense: it is, indeed, much more than an ordinary day. According to our habit of thought, a day is invariably associated with alternations of light and darkness; and each day, moreover, has a definite relationship to some locality on the surface of the earth. The day, as we commonly understand it, is essentially local; and during each rotation of the globe on its axis, occupying a period of twenty-four hours, there are as many days as there are spots on sea and on land differing in longitude. These numberless days are separate and distinct, each having its noon and midnight, its sunrise and sunset. The time-unit is an entirely different conception: it is equal in length to a day, and must, from its nature, be synchronous with some one of the infinite number of local days. By the resolutions of the Washington conference, it is identified with the civil day of Greenwich. But while the latter is simply a local division of time, limited to the Greenwich meridian, the unit measure is, on the other hand, not so limited: it is equally related to all points on the earth's surface in every latitude and longitude. Under this aspect, the wider functions and general character of the unit measure remove it from the category of ordinary days, as we understand the familiar expression; and, to obviate all doubt and uncertainty regarding it, it is in the highest degree desirable that the universal time-unit should be distinguished by some appellation by which, apart from its local relationship, it may always be indisputably known.

It was Lord Chief Justice Coke who said that "error is the parent of confusion." As the primary object of time-reform is to obviate confusion, we should take every precaution to preclude error. Is it not, therefore, expedient that we should adopt means to secure a proper and appropriate designation for the unit measure, and abandon as misnomers each one of the terms which have hitherto been applied to it? In a paper on the subject of time-reckoning, published in the "Transactions" of this society in 1886, the unit measure is defined, its uses described, and it is likewise pointed out that its distinctive appellation remains undetermined. I consider it to be my duty to draw attention to the want; and, while it would be an act of presumption on my part to propose a name, I will venture the remark that in the general interests of science an effort should be made to supply it. It has been found expedient to derive technical terms from a classical etymology, and I beg leave to suggest that the same rule might be followed in this case with obvious advantage. Whatever name be chosen, if derived from a Greek or Latin root, the word would in all countries have the same definite meaning, and could readily be incorporated into all languages. If such a word be adopted as will clearly express "a unit measure of time," it will gradually come into general use, as in the parallel cases of "telegram," "telegraph," "photograph," "lithograph," etc.; and by this means all nationalities will be enabled to give expression to one and the same meaning when they refer to time-reckoning in its broad significance.

I humbly submit that the Royal Society of Canada will confer a general benefit, and act becomingly, by taking the initiative in obtaining an appropriate designation for the unit measure of time.

If that view be concurred in by this section of the society, I respectfully suggest that a special committee be appointed to consider the subject, with instructions to report during the present session.[1]

NOTES AND NEWS.

A LABORATORY for plant-biology has been recently opened at Fontainebleau, says *Nature* of Sept. 11. It is under the direction of M. Bonnier, professor of botany at the Sorbonne in Paris, to whom application should be made by any contemplating research there.

—In the London *Times* for Sept. 9 we read the following note on how to keep salt dry: "The Dutch Indian Government offers a prize of 10,000 fl. for the best practical answer to the question 'In what manner should the salt which is sold in Dutch India in small packets be packed up so as to keep dry?'"

—The fifty-ninth annual exhibition of the American Institute of this city will open on Oct. 1, and continue until the end of November. The institute's exhibition building covers the large block of ground between Second and Third Avenues and 63d and 64th Streets, affording ample space for a display which is looked forward to with increasing interest from year to year.

—A wonderful example of erosion may be seen in the illustration to Professor Michie Smith's article on the eruption of Bandaisan in the *Proceedings of the Royal Society of Edinburgh*, vol. xvii. p. 70. The valley there depicted was produced by the erosive power of a small stream within the short space of ten months. Its depth, when Professor Smith visited the neighborhood, was 80 feet, and in some places little short of 150 feet.

—It is a fact known to few, that Russia has taken a place among the quicksilver-producing countries. We note in *The Scottish Geographical Magazine* that this metal is at present extracted at two places,—near the village of Kurush in Dagestan: and near the village of Saizef, in the district of Bachmut in Ekaterinoslav. At the former place the ore is said to contain the enormous proportion of 74.7 per cent of quicksilver. At Saizef, where the ore contains only 0.32 to 4.5 per cent, the pure metal extracted in 1889 weighed 164½ tons. Diamond-boring has lately been adopted, and a fairly rich lode of cinnabar has been struck at a depth of 260 feet.

—The special committee of Section III. of the Royal Society of Canada, to whom the expediency of suggesting an appropriate name for the unit measure of time was referred, reported as follows at the general meeting of the society held May 29, 1890: "The committee recognizes the advisability of obtaining a suitable nomenclature, and concurs in the views expressed in the address of the president of the section as to the expediency of

[1] This report is given elsewhere as a note.

some steps being taken by the society; the committee is likewise of opinion that we must seek in the classical languages for the material to construct an appropriate word, which will command the acceptance of every nationality. The committee conceives, that, whatever may be the individual opinions of members of this society, it is not at present expedient to do more than draw attention to the requirement. Your committee therefore recommends, that, in the name of the Royal Society of Canada, correspondence be opened with sister societies in other parts of the world with the view of bringing the subject to their notice, asking the favor of an expression of opinion regarding it. The committee recommends that the council be requested to take such steps as may be deemed expedient to bring the subject to the attention of sister societies."

— At a special meeting of the Geographical Society of Paris held on the 28th of June, M. Fernand Foureau gave an account of his journey to In-Salah, undertaken in pursuance of a mission intrusted to him by the ministers of public instruction and commerce. As related in the "Proceedings of the Royal Geographical Society," London, the traveller started from Biskra. At Aïn-Taïba he crossed the route of M. Leon Say in 1878, and of the first expedition of Col. Flatters. Continuing to the south-west, he traversed the region of the Erg. The chains of sand-dunes here attain an elevation of 1,200 feet, and are separated by "gassis" 20 to 30 miles in length, and ¾ to 1½ miles in breadth, which broaden farther in the interior. Vegetation at the foot of the dunes is green and abundant. A species of tamarisk is found on the summits. At the Ued Auleggui, M. Foureau struck the route of the second Flatters mission. Ascending an affluent of this Ued, he reached the watershed (about 1,200 feet high) between the basins of the Igharghar and the Ued Massin. The next range of importance, that of the Baten, running in a north-east and south-west direction, forms the edge of a deeply eroded plateau. The traveller here turned to the north east, and skirted the region of the Erg, exploring the estuaries of the numerous streams which descend from the Tademayt. These estuaries are covered with small shrubs and plants; but the expedition found their beds completely dried up, owing to the absence of rain for the last two years. The principal geographical results of this expedition are as follows: M. Foureau has determined the latitudes and longitudes of thirty-five points, and taken barometrical observations along the entire route. The length of his itinerary was over 1,500 miles, 600 of which were beyond the frontier of South Algeria. M. Foureau has shown that between Uargla and In-Salah there is a practicable route for a railway, on a firm soil, without a dune along it.

—Professor Klossovsky of Odessa has been investigating the physical characteristics of the Black Sea, as we learn from *The Scottish Geographical Magazine*. He finds its area, including the Sea of Azov, to be 147,100 square miles. Its greatest depth lies between Sevastopol and Constantinople, and is considerable for an inland sea, being 1,166 fathoms. The salinity on the north-west coast is 1.43 per cent, in the open sea 1.76, and at great depths 1.9, whereas in the Mediterranean and in the Atlantic, in the region of the trade-winds, it is 3.7 per cent. The temperature of the air over the surface of the sea is in summer about 72°. In the winter months it rises towards the southern shore, varying in January from 35½° on the northern shore, to 43° on the coast of Asia Minor. In summer the prevailing winds blow from the land towards the sea; in winter, in the opposite direction. The Black Sea is restless and stormy, for strong winds and gales blow over its shores on ninety days in the year. Professor Klossovsky gives full details concerning the variations of the level of the sea, having obtained records of observations made at nineteen stations during seventeen years. In the summer months the water near the shores stands above, in the winter months below, the mean level. The monthly mean of these variations is only one foot, but the absolute differences of level are very great,—in Taganrog nearly 14 feet 4 inches. The mean level for the year is nearly constant. Professor Klossovsky considers that these variations are independent of the rainfall, and are due to variations of atmospheric pressure, winds blowing from the land depressing the surface of the sea. It might, then, be expected that a rise of the water on one side of the sea would be accompanied by a sinking on the other side, and observations prove that such is the case. In summer the water is subject to sudden changes of temperature, sometimes amounting to fourteen or fifteen degrees in a day. This may be caused, partly by the action of the waves in mingling together the upper and lower strata, and partly by the winds, which, blowing off shore, sweep away the warmer surface water.

—The Rev. Dr. Norman has just returned from a dredging expedition in the Varanger Fiord and Sydvaranger, says *Nature* of Sept. 11. He has been absent nine weeks, and has brought home extensive collections in all branches of marine *Invertebrata*. The fiords of Sydvaranger were found to possess a rich fauna, with depths descending to 120 fathoms. These fiords had never before been scientifically investigated, though Baron de Guerne took a few hauls of the dredge there in 1881, when on board the French vessel "Coligny" as a member of the Mission Scientifique en Laponie, and published a list of the *Mollusca* obtained.

— A new method of measuring the inductive power and conductivity of dielectrics has been described by M. Curie in the *Annales de Chimie et de Physique*. It is based on the use of an apparatus he calls the piezo-electric quartz. He has studied with it, as we learn from *Nature* of Sept. 11, those qualities in various crystalline dielectrics; and he enunciates a law of superposition, which shows the independence of the effects produced by different variations of electro-motive force. Quartz shows a difference of conductivity in the direction of the optic axis (where it is strong), and at right angles (where it is insensible); and this gives rise to striking phenomena. Plates parallel to the axis, and with the extremities of the axis communicating with the earth, behave, beyond 120°, as dielectrics of zero inductive power. With prolonged heating, the conductivity along the axis quite disappears. Water plays a capital *rôle* in the conductivity of a great many dielectrics, possibly in all. With plates of baked porcelain kept moist, the various types of conductivity could be reproduced. The electro-motive forces of polarization of moist porous bodies may attain several hundred volts.

—The United States consul at Mannheim, Germany, says that in Mannheim and the neighborhood there are several large factories worked by steam, with enormous machines employing hundreds of hands, engaged in preparing feathers for market. The feathers, says the London *Journal of the Society of Arts*, come in great quantities from Russia, Austria, and other parts of Europe, and also Asia, China especially sending vast quantities in a very dirty condition. The feathers come into the factory in large bales. These are opened near a kind of gin or breaker, which separates the feathers from a lumpy or bunchy form, and flings them around in an air-filled chamber, through which a constant current is blowing. From this machine they go to another, in which, by means of ventilators, a separation of the short and light feathers from the long and heavy is made. Stage after stage, through machines arranged and shaped much like cotton-gins, the feathers fly, each machine separating the lighter from the heavier, until the most delicate, flaky snow-down is flung out into a large chamber. In one stage of the process the feathers are cleansed. This is done by placing them in a large steam-heated boiler, into which steam is projected, and made to cleanse every particle of dirt from the feathers. Long before the feathers get time to be wet through by the steam, dry air is injected from one side, while suction currents draw off every particle of dust or dirt loosened by the steam. The largest feathers, those which on account of the long quills are unfitted for use, are sent to the State prisons, where for very small sums the "wings" are carefully torn from the quills and returned to the factory, where they are cleansed and prepared for market. Most of the factories endeavor to get out of the feathers as much as possible of the down. A very fine quality of this article, that of the eider duck, fetches about $3.50 a pound. The machines are very simple in character and construction, and require in their working no special skill. They consist of breakers and ventilators. Contrivances for catching dust have been invented, but never any so skilfully contrived as to keep the fine particles from finding their way into the open rooms, and thence into the lungs of the work-people.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

IMPERIAL UNIVERSITY OF JAPAN.

INASMUCH as the Teikoku Daigaku, or Imperial University, owes its existence to the union of the late Tōkyō Daigaku and Kōbu Daigakkō, it seems fitting, that, in tracing its history, reference should be made to the origin of these two institutions.

The four departments of law, science, medicine, and literature, which composed the Tōkyō Daigaku, sprang, with the one exception of the department of medicine, from an institution of some antiquity, founded by the Tokugawa Government, and known first as the Yōgakujo, and afterwards as the Kaiseijo. This institution was, after the restoration of 1868, revived by the Imperial Government, and in January of the following year it opened its doors anew for the first time. Special attention was devoted to instruction in English and French, to which languages German was soon afterwards added. In December of the same year the college received the name of "Daigaku Nankō," or South College, because of its location at Hitotsubashi to the south of the central Daigaku, to which it was attached. The central Daigaku was situated in the old Gakumonjo at Yushima.

The Daigaku having been abolished in the year 1871, the Daigaku Nankō, known simply as the Nankō, came directly under the control of the department of education; and in the following year, when the country was mapped out into educational districts, it received the name of the "First Middle School of the First Grand Educational District."

In April of 1873 the name of the institution was changed to "Kaisei-Gakkō," and special courses of studies were instituted in law, chemistry, engineering, polytechnics, and mining. In the same year the institution was transferred to the new buildings just completed at No. 1 Nishikichō Sanchōme (Hitotsubashi Soto). In 1874 the word "Tōkyō" was prefixed to the name of the institution, and it was called the "Tōkyō Kaisei Gakkō." In April of 1876 the department of education united this institution and the Tōkyō Igakkō, or Medical College, so as to form the Tōkyō Daigaku or Tōkyō University, comprising the four departments of law, science, medicine, and literature. The departments of law, science, and literature were combined in one institution, and one president was appointed for all three. Another president had charge of the medical department.

The medical department sprang out of the Igakujo,—an institution in Shitaya originally belonging to the Tokugawa Government, and revived by the Imperial Government in 1868. In the following year this school and the hospital established for the tending of the wounded in the war of 1868 were united under the name of the "Medical School and Hospital." Soon afterwards the combined institution was attached to the Daigaku, and received the name of "Daigaku Tōkō," or East College, because of its position to the east of the central Daigaku. In 1871 it shortened its name to "Tōkō," and in 1872 assumed the name of "Igakkō," or "Medical College in the First Grand Educational District," which title was again changed to "Tōkyō Igakkō" in the year 1874.

In 1876, the new buildings at Hongō having been completed, the college was transferred thither from Shitaya. In 1877 the college became the medical department of the Tōkyō Daigaku, or Tōkyō University. In 1881 the organization of the Tōkyō Daigaku was modified by the appointment of a president who should have control not only of the four departments of law, science, medicine, and literature, but also of the preparatory school. In September of 1884 the departments of law and literature removed to the new brick building in Kaga Yashiki, Hongō.

During the year 1885 various changes occurred. The central office of the university was transferred to a building in the compound at Hongō, the preparatory school dissolved its connection with the university and became an independent institution, the department of science also removed to Hongō, and the Tōkyō Hōgakkō or Law School, under the control of the department of justice, was merged in the university. Also in the same year the department of technology was created; and courses in mechanical and civil engineering, mining, applied chemistry, naval architecture, and kindred subjects were transferred to the new department from the science department. The course of politics in the literature department was likewise transferred to the law department, henceforward to be known as the "Department of Law and Politics."

The Kōbu Daigakkō, originally known as the "Kōgakkō," was instituted in 1871 in connection with the Bureau of Engineering in the Public Works Department of the Imperial Government. The institution was in 1872 divided into the college and the preparatory school. In 1874 the preparatory school was actually opened for instruction in Yamato-Yashiki, Tameike; and in 1876 an art school was created in connection with the college.

In 1877 the Bureau of Engineering was abolished, and the college was thenceforth called the "Kōbu Daigakkō," or "Imperial College of Engineering." The same year witnessed the completion of the large new buildings at Toranomon, containing a central hall, classrooms, laboratories, dormitories, and the full equipment necessary for such an institution.

In June, 1882, the term of engagement of the head professor, Mr. Henry Dyer, expired. He first arrived in Japan in June, 1873, was appointed head professor, and occupied at the same time the chair of civil engineering. When he first arrived, the college was still in its infancy; and he set himself to plan the curriculum, and formulated the various college rules and regulations. He also planned the college building. As head professor, he discharged his duties with untiring diligence for the long pe-

riod of almost ten years. For these reasons, when he was leaving Japan, he was decorated with the third order of the Rising Sun, and was also appointed honorary head professor of the engineering college.

In 1882 the art school was discontinued. In 1885 the Department of Public Works was abolished,—an event which caused the college to be transferred to the control of the department of education.

In the late Tōkyō Daigaku and Kōbu Daigakkō, the following degrees were conferred on the graduates by their respective authorities: *Hōgakushi* in the department of law, *Rigakushi* in science, *Igakushi* in medicine, *Bungakushi* in literature, and *Kogakushi* in engineering.

On the 1st of March, 1886, the Imperial Ordinance No. 3 was promulgated for the organization of the Teikoku Daigaku, or Imperial University, and the Tōkyō Daigaku and Kōbu Daigakkō were merged in the new institution. H. E. Hiromoto Watanabe, then the governor of Tōkyō, was appointed president of the university. In April, curricula of instruction for the several colleges of the university were established. Each course extends over three years, excepting the course in medicine, which extends over four years. In the same month the Tōkyō Shokkō Gakkō (School of Industrial Technology) was placed under the control of the university. In November the five principal private law schools in the city were placed under the supervision of the university. A supervising committee for these schools was formed among the professors of the College of Law, who became responsible for the courses of instruction and the method of examining the students. In December of the same year a marine zoölogical station was established at Misaki, a town situated at Cape Miura, in Sagami.

In May, 1887, the Imperial Ordinance No. 13 was promulgated, establishing regulations for learned degrees; and in June of the same year by-laws connected with these regulations were issued by the minister of state for education. In July it was decided that graduates of the colleges should be entitled to call themselves *Hōgakushi*, *Igakushi* (*Yakugakushi* in the case of graduates in the course of pharmacy), *Kōgakushi*, *Bungakushi*, and *Rigakushi* respectively, according to the course which they had pursued; and that *Jun-igakushi* of the Tōkyō Daigaku, and graduates of the Kōbu Daigakkō who had not received degrees, should be allowed to call themselves *Igakushi* and *Kōgakushi* respectively, after obtaining the sanction of the president of the university, to whom a formal application must be made, and a history given at length of their professional career after graduation.

In October the Tōkyō Shokkō Gakkō was separated from the university. In March, 1888, the powers and duties of the president of the university were formally fixed by the minister of state for education. In the same month a notification was issued by the education department, regulating the income, from tuition fees and various other sources, of all educational institutions under the direct control of the department, with the object of supplying each with a capital fund. In May the university was released from the duty of supervising the five principal private law schools in Tōkyō.

The Tōkyō Observatory was established at Iigura in the month of June. This institution, formed by the amalgamation with the University Observatory, of the Astronomical Section of the Home Department and the Astronomical Observatory of the Imperial Navy, was placed under the control of the Imperial University, which was accordingly intrusted with the duty of publishing the Astronomical Almanac.

On July 31 the College of Engineering was moved to the new brick building just completed for its use in the compound at Hongō. On the 30th of October of the same year a temporary committee for the compilation of the national history was established. This was due to the disestablishment of the temporary board for the compilation of the national history in the Naikaku, and to the subsequent intrusting of the work to the Imperial University. On the 20th of December of the same year the College of Science was removed to the new building then completed.

The Imperial University is under the control of the minister of state for education, and depends for its revenue upon annual allowances from the treasury of the Imperial Government. The tuition fees and other sources of income are allowed to accumulate year by year, so as to form a large fund. A certain portion of this fund is, however, to be paid out in some cases towards the current expenditure of the university, when the cases are of such a nature as to demand the outlay.

The whole university—viz., the offices of the university, the university library, the colleges of law, medicine, engineering, literature, and science, the First Hospital of the College of Medicine, and the dormitories of the colleges—is situated in the extensive grounds at Motofujichō, Hongō, Tōkyō, known as Kagayashiki. The Botanic Garden is located at Koishikawa, the Tōkyō Observatory belonging to the university at Iigura, and the Second Hospital of the Medical College at Shitaya, all within the city limits. The Marine Biological Station of the university is situated at Misaki, a town on the north side of the entrance to the Bay of Tōkyō.

THE CHEAPEST FORM OF LIGHT.[1]

THE object of this memoir is to show, by the study of the radiation of the fire-fly, that it is possible to produce light without heat other than that in the light itself, that this is actually effected now by nature's processes, and that these are cheaper than our industrial ones in a degree hitherto unrealized. By "cheapest" is here meant the most economical in energy, which, for our purpose, is nearly synonymous with "heat;" but, as a given amount of heat is producible by a known expenditure of fuel at a known cost, the word "cheapest" may also here be taken with little error in its ordinary economic application.

We recall that in all industrial methods of producing light there is involved an enormous waste, greatest in sources of low temperature, like the candle, lamp, or even gas illumination, where, as has already been shown, it ordinarily exceeds 99 parts in the 100; and least in sources of high temperature, like the incandescent light and electric arc, where yet it is still immense, and amounts, even under the most favorable conditions, to very much the larger part.

It has elsewhere[2] been stated, that, for a given expense, at least one hundred times the light should in theory be obtainable which we actually get by the present, most widely used methods of illumination. This, it will be observed, is given as a minimum value; and it is the object of the present research to demonstrate that not only this possible increase, but one still greater, is actually obtained now in certain natural processes, the successful imitation of which we know of nothing to prevent.

It is now universally admitted that wherever there is light there has been expenditure of heat in the production of radiation, existing in and as the luminosity itself, since both are but forms of the same energy; but this visible radiant heat which is inevitably necessary is not to be considered as waste. The waste comes from the present necessity of expending a great deal of heat in invisible forms before reaching even the slightest visible result; while each increase of the light represents not only the small amount of heat directly concerned in the making of the light itself, but a new indirect expenditure in the production of invisible calorific rays. Our eyes recognize heat mainly as it is conveyed in certain rapid ethereal vibrations associated with high temperatures, while we have no usual way of reaching these high temperatures without passing through the intermediate low ones; so that, if the vocal production of a short atmospheric vibration were subject to analogous conditions, a high note could never be produced until we had passed through the whole gamut, from discontinuous sounds below the lowest bass, up successively through every lower note of the scale till the desired alto was attained.

There are certain phenomena, long investigated yet little understood, and grouped under the general name of "phosphorescent," which form an apparent exception to this rule, especially where

[1] Abstract of an article by S. P. Langley and F. W. Very, published in the American Journal of Science for August, 1890.

[2] See results of an investigation by S. P. Langley, read before the National Academy in 1883, and given in Science for June 1, 1883, where it is shown that in the ordinary Argand burner gas-flame indefinitely *over* 99 per cent of the radiant energy is (for illumination purposes) waste.

nature employs them in the living organism; for it seems very difficult to believe that the light of a fire-fly, for instance, is accompanied by a temperature of 2000° F. or more, which is what we should have to produce to gain it by our usual processes. That it is, however, not necessarily impossible, we may infer from the fact that we can, by a known physical process, produce a still more brilliant light without sensible heat, where we are yet sure that the temperature exceeds this. No sensible heat accompanies the fire-fly's light, any more than need accompany that of the Geissler tube; but this might be the case in either instance, even though heat were there, owing to its minute quantity, which seems to defy direct investigation. It is usually assumed, with apparent reason, that the insect's light is produced without the invisible heat that accompanies our ordinary processes; and this view is strengthened by study of the fire-fly's spectrum, which has been frequently observed to diminish more rapidly toward the red than that of ordinary flames.

Nevertheless, this, though a highly probable and reasonable assumption, remains assumption rather than proof, until we can measure with a sufficiently delicate apparatus the heat which accompanies the light, and learn not only its quantity, but, what is more important, its quality. Apart from the scientific interest of such a demonstration, is its economic value, which may be inferred from what has already been said. It therefore seems desirable to make the light of the fire-fly the subject of a new research, in which it is endeavored to make the bolometer supplement the very incomplete evidence obtainable from the visible spectrum.

As we may learn from elementary treatises, phenomena of phosphorescence are common to insects, fishes, mollusks, vegetables, and organic and mineral matter. Among luminous insects the fire-fly of our fields is a familiar example; though other of the species attain greater size, and perhaps greater intrinsic brilliancy, especially the *Pyrophorus noctilucus* Linn., found in Cuba and elsewhere. Its length is about 37 millimetres, width 11 millimetres, and it has, like *Pyrophori*, three light-reservoirs,—two in the thorax, and one in the abdomen. To procure this Cuban fire-fly, the aid of the Smithsonian Institution was sought, and through the kindness of Professor Felipe Poey of Havana, and Señor Albert Bonzon of Santiago de Cuba, in the Island of Cuba, living specimens of the *Pyrophorus noctilucus* were received during the summer of 1889.

After a preliminary spectral examination in Washington, it was found more convenient to continue the research at the Allegheny Observatory by means of the very special apparatus supplied by the liberality of the late William Thaw of Pittsburgh, for researches in the lunar heat-spectrum. Photometric measurements throughout the spectrum of the insect's light were also made.

Resuming, then, what we have said, we repeat, that nature produces this cheapest light at about one four-hundredth part of the cost of the energy which is expended in the candle-flame, and at but an insignificant fraction of the cost of the electric light or the most economic light which has yet been devised; and that finally there seems to be no reason why we are forbidden to hope that we may yet discover a method (since such a one certainly exists, and is in use on the small scale) of obtaining an enormously greater result than we now do from our present ordinary means for producing light.

HEALTH MATTERS.

Female Medical Students in India.

THE study of medicine is becoming very popular with the native women of India. At the close of the academic session in 1889, says the *Medical Record*, there were 24 female students at the Calcutta Medical College, 14 at the Campbell Medical School, and 5 at the Cuttack Medical School. At Agra, during the year, 7 young women received licenses to practise. At Lahore there were 19, and at Madras 39, female medical students, one of the latter being the first to take the degree of M.B. at the Madras University. There were also female students at the Grant Medical College of Bombay, and at the Government Medical Schools at Poonah, Ahmedabad, and Hyderabad. The movement was initiated a few years ago by Lady Dufferin, the wife of the Viceroy of India. Madame Pim, a diplomaed surgeon from Paris, has settled down in Bengalore, and is doing a large practice among the Zenana ladies there. A Bengalore paper believes that there is ample room for a lady surgeon or two in the Mysore Province, and it is said that the Maharajah will offer a scholarship to any girl student of the Maharanee's College who cares to enter on a course of medical study at the Madras Medical College. It is also stated in the *Indian Medical Gazette* that a large number of female pupils at the Agra Medical School have just passed their final examinations. These include several students who were especially sent by the Durbars of Ulwar and Tezpur and the municipalities of Etah, Fyzabad, and Raipur.

Treatment of Diphtheria.

In the *Répertoire de Pharmacie* for July 10, 1890, it is stated that Dr. Babchinski was attending a case of grave diphtheria occurring in his own son, in which a rapid change for the better occurred coincidentally with the appearance of erysipelas on the face. The fever rapidly fell, the false membrane disappeared, and cure rapidly took place. Dr. Babchinski also states (*The Therapeutic Gazette*) that in several other cases he noted a great improvement coincident with the appearance of erysipelas, and in one of them the erysipelas occurred on the leg, and not on the face. These facts suggested to Dr. Babchinski the idea of inoculating diphtheria cases with blood taken from patients suffering from erysipelas, and he states that in several cases in which he employed this procedure cure resulted. Later on, he practised inoculation of other cases of diphtheria with cultures of the microbe of erysipelas in agar-agar, and likewise noticed the disappearance of the symptoms of diphtheria. He further adds, that, when the inoculations were made, all special treatment was suspended, and in no case did the erysipelas present any sufficient gravity to cause uneasiness. He concludes by stating, that, if his observations and experiences are confirmed, this treatment should rob diphtheria of all its dangers.

The Work of a Health-Officer.

Dr. Frank W. Wright, the health-officer of New Haven, in his annual report just issued, expresses himself on some important points as follows:—

"In making this report, I feel that I should express the opinion that it is the duty of the Board of Health to take as active measures to preserve the good health of the community as it does to suppress the spread of disease after it has made its appearance. I know that public sentiment is directly opposed to any progress, and always will be until sickness and death have caused serious havoc; and then the cry will go forth, 'Why has the Board of Health done nothing to prevent this?'

"It is urgently demanded, in justice to yourselves and by all who wish to have our city regarded as a sanitary locality, that your board should see that a proper bill is introduced before the next Legislature, more fully defining your powers, and granting power to you in such directions as seems to you necessary for the preservation of the public health.

"The code of plumbing laws now pending before the Court of Common Council, if adopted, will be a step in the right direction. I firmly believe that more sickness is caused in this city by poor plumbing than by any other single condition. This is proved by the fact that the death-rate is larger every month in those wards where the prevailing plumbing is rusted-out sheet-iron pipes, loose joints, and untrapped sinks, than in those wards where the plumbing is generally good. I have carefully prepared a comparison of the three wards where the plumbing is the poorest with the three wards that have the best plumbing. As the wards representing poor plumbing, I have taken the third, fourth, and seventh. For the year ending Nov. 30, 1889, the death-rate per thousand was 20.6, 16.4, and 20.8 respectively. In the wards representing good plumbing, the first, eighth, and tenth, the death-rate per thousand for the same year was 7.9, 12.8, and 13.1 respectively. To any fair-minded person this must be convincing."

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The Rotatory Motion of Heated Air.

Noticing that Professor Hazen questions, in *Science*, the rotatory theory of tornadoes, it occurs to me to publish an observation that I recently made, which may have some bearing on this subject. Not long ago, while watching the surface of a cup of hot tea, which contained some sugar, but no milk or cream, my attention was attracted to the phenomena presented on its surface. Close to the hot liquid, and covering it quite evenly, was a thin layer of condensed vapor. The air of the room was still, and I protected the film from my breath, as I watched it. I saw the film in constant motion. At one or two points at a time the vapor acquired two motions,—one in a whorl, and one progressive. In the former the motion was first visible at the exterior, in a circle a little more than half an inch in diameter. The broad part of each ray of the whorl appeared first, and afterward the parts near the focus were developed, and were rotated or twisted round the focus at a relatively rapid rate. As this took place, the whole whorl advanced across the surface of the liquid until the whorl disappeared, and the clear surface appeared without any film above it. Sometimes only one whorl was in sight, sometimes two appeared at once. This phenomenon was repeated until no more vapor was visible above the liquid.

As it appeared to me, there were here conditions favorable to observing the behavior of moisture-laden air over a super-heated level surface. Some condition which escaped notice must have determined the point at which a special motion was initiated; but the uniformity with which this developed into a centripetal rotatory and advancing movement was quite impressive. How far the conditions of the observation coincide with the conditions present in tornadoes, those who are competent to discuss meteorological questions may decide. Charles W. Dulles.

Philadelphia, Sept. 20.

AMONG THE PUBLISHERS.

"The Essentials of Medical Chemistry and Urinalysis," by Sam E. Woody, M.D., published by P. Blakiston, Son, & Co., has reached a third edition, which would indicate that the book, which is small, is filling its place.

— Another characteristic brochure by Professor Henry Drummond, under the title of "Perfected Life, the Greatest Need of the World," has just been issued uniform with the popular booklet "Love the Supreme Gift, or the Greatest Thing in the World." Both are published by Fleming H. Revell, New York and Chicago.

— We have received from Messrs. Dauchy & Co.'s Newspaper Advertisement Agency, 27 Park Place, New York, their "New Catalogue of American Periodicals," a volume of 624 pages. It contains a list of all newspapers, magazines, and other periodicals in the United States and Canada which insert advertisements, and is corrected up to Aug. 15 of this year.

— Messrs. Macmillan & Co. have just issued "The Parabola," being Part I. of "Geometrical Conics," by Rev. John J. Milne and R. F. Davis. Instead of following the usual plan, the authors have endeavored to make a continuous treatise as distinguished from a series of detached propositions. At the close of the book is a valuable collection of problems.

—Dr. Charles M. Andrews of Bryn Mawr College will publish in the October number of the *Annals of the American Academy of Political and Social Science* an interesting article on "Beginnings of the Connecticut Towns." The Constitution of 1639 has a wider than local interest, since it was the first written constitution, the prototype of Republican government on this continent. It is a question of no small importance, therefore, whether the Constitution was founded by the towns as such or by the people. This is the question discussed by Dr. Andrews. A painstaking study of the facts leads him to the conclusion, in opposition to the late Alexander Johnston and many others, that Connecticut draughted its organic law on the theory "that the sovereignty of a State is in the people of that State."

—Another example of the rapid growth of chemical literature is shown in the appearance from the press of John Wiley & Sons of "Sugar Analysis," by Ferdinand G. Wiechmann, Ph.D. Dr. Wiechmann is instructor in chemical physics and chemical philosophy at the School of Mines, Columbia College, and is consulting chemist to the Havemeyers & Elder Sugar Refinery Company of Brooklyn. The work is intended as a handbook of instruction in schools of chemical technology, and for use in the refineries, sugar-houses, and experiment stations. Within the past few years many changes have been introduced in the methods of sugar analysis, and new methods have been devised, and, as is usual with such matters, the literature is scattered through numerous foreign journals. It has been Dr. Wiechmann's purpose to bring this new matter together into such shape as to make it available for those directly interested. The methods of analysis which he has selected from the vast wealth of material available have been chosen after long trial and practice under the supervision of the author. Instead of taking up for discussion, as is usual, the different products met with in sugar laboratories, such as raw sugars, refined sugars, liquors, molasses, etc., and describing for each in turn the determination of their constituents, the author has deemed it more expedient to discuss the methods of determining the individual constituents, as sucrose, invert sugar, water, ash, etc., independently of the products in which they may occur. He believes that by the adoption of this plan repetitions have been avoided. Examples have been inserted in the text to aid in the understanding of the principles discussed, and of the calculations. As is usual with such works, various references to original memoirs are given. The book is furnished with numerous tables, as is required in such a subject.

—The twentieth anniversary of *The Century* is celebrated by the publication of the next (November) number. *The Century* series of separate illustrated papers on the movement to California in 1849 and the events which preceded it, begins in the November number with a narrative, by Gen. John Bidwell, of the experiences of the first emigrant train to California. There is no part of the world, of equal civilization, of which so little has been divulged as of Thibet. A well-qualified American traveller, Mr. W. Woodville Rockhill, has recently returned from a journey through this the unknown heart of Asia, and will give in a series of illustrated papers the results of his travels and observations. For seven hundred miles of Mr. Rockhill's journey he passed through a country where no white man had ever set foot. Among the articles promised are some on "The Personal Traits of Lincoln," "Adventures of War Prisoners," "Minister Dallas at the Court of the Czar Nicholas," "Indian Fights and Fighters," "American and English Frigates in the War of 1812," "'The Faith Doctor'" (by Edward Eggleston), "Mmes. De Staël, Roland, and Récamier," "Pictures by American Artists," "American Newspapers," "Municipal Government in Europe and America," and "Present Day Papers." This last unique series of well-considered utterances by prominent writers, on the great questions of the day, will be continued during the coming year. The group has recently added to its own number, and now consists of the following: Charles W. Shields, Hugh Miller Thompson, Henry C. Potter, Charles A. Briggs, Theodore T. Munger, Washington Gladden, William Chauncey Langdon, Francis G. Peabody, Samuel W. Dike, William F. Slocum, jun., Seth Low, Edward J. Phelps, Richard T. Ely, William J. Sloane, and Charles Dudley Warner. The above list gives only a part of the contents of the new year, special announcements of features in preparation being reserved. Mr. George Kennan, who was interrupted in the preparation of his concluding papers, will, it is expected, before long give further chapters of the story of his travels in Siberia and Russia; Mrs. Van Rensselaer will publish her final papers on English cathedrals; and Mr. La Farge will give his views of art in general, and especially of modern and Western art methods, from the point of view of an Oriental residence.

— Messrs. Macmillan & Co. will publish early next month, in their Adventure Series, "The Buccaneers and Marooners of America" (edited and illustrated by Howard Pyle), being an account of the famous adventures and daring deeds of certain notorious freebooters of the Spanish Main. Mr. Gladstone's new book, entitled "Landmarks of Homeric Study," will be issued immediately by the same firm. The author says in a recent letter, "Please to bear in mind that this little work was planned for America. The form of it seemed to me more suited for an American public."

—Among the new books of C. W. Bardeen, Syracuse, N.Y., is "Home Exercise for Health and Cure." This is a translation of a German work by D. G. R. Schreber, M.D., which is said to have sold in Germany to the extent of 140,000 copies. The purpose of the book is to furnish a cheap, easily understood, and practicable system of physical exercise.

— Those interested in chemical analysis will find much to interest them in "Electro-Chemical Analysis," by Edgar F. Smith, just published by P. Blakiston, Son, & Co. The author is professor of analytical chemistry at the University of Pennsylvania. These electro-chemical methods of quantitative analysis are in the main new, and are constantly being used to a greater and greater extent. Professor Smith has done a service in giving chemists this book, which is rendered the more valuable by a profuse but not obtrusive amount of reference to the literature.

—Those having classes in solid geometry should send to Macmillan & Co. for a copy of Hayward's "Elements of Solid Geometry." The author, who is a fellow of the Royal Society, and is senior mathematical master in Harrow, has produced a compact text-book which departs from the Euclid so beloved in England, and is likely to find many users on this side.

—The forthcoming visit of the Count of Paris to this country will no doubt excite great public interest, and *The Illustrated American* has endeavored to cater to this by a lengthy article, profusely illustrated with portraits and scenes with particular reference to the distinguished visitor's career in our civil war. Those who do not know *The Illustrated American* should buy copies for a few weeks, and they are sure to find matters of interest. The recent series of illustrations of French artists and writers at their work were of special value.

— Among the fall announcements of Messrs. Macmillan & Co. we note the following as of interest to our readers: "Wild Beasts

and their Ways," by Sir Samuel White Baker, author of "Albert Nyanza," etc.; "Physical and Political School Atlas," consisting of 80 maps and complete index, by J. G. Bartholomew; Behaghel's "The German Language," translated and adapted for the use of English schools by Emil Trechmann; "An Elementary Geography of India, Burma, and Ceylon," by H. F. Blanford, late meteorological reporter to the Government of India; "A Manual of Public Health," by A. Wynter Blyth, author of "A Dictionary of Hygiene and Public Health;" "Croonian Lectures, On the Connexion between Chemical Constitution and Physiological Action, being an Introduction to Modern Therapeutics," by T. Lauder Brunton, author of "A Text-Book of Pharmacology, Therapeutics," etc.; "The Oxford Movement," by R. W. Church, dean of St. Paul's; "Elementary Manual of Applied Mechanics," by Professor J. H. Cotterill and J. H. Slade; "Handbook of Field and General Ornithology," a manual of the structure and classification of birds, with instructions for collecting and preserving specimens, by Professor Elliott Coues; "Maps and Map Drawing," by William A. Elderton; "Elements of Physics for Public Schools," by C. Fessenden, High School, Napanee, Ontario, Canada; "A Text-Book of Physiology," by Michael Foster; "Class Book of Geology," by Archibald Geikie; "A Short Manual of Philology for Classical Students," by P. Giles; "The Geometry of Position," by Robert H. Graham, author of "Graphic and Analytical Statics;" "Electricity and Magnetism," by A. Guillemin, translated and edited by Professor Silvanus Thompson; "Text-Book of Pathology," by D. J. Hamilton; "The Elements of Solid Geometry," by R. Baldwin Hayward; "Mixed Metals and Metallic Alloys," by Arthur H. Hiorns, author of "Practical Metallurgy and Assaying," "Elementary Metallurgy," "Iron and Steel Manufacture," etc.; "Sound, Light, and Heat: An Elementary Text-Book," by D. E. Jones, author of "Examples in Physics," etc.; "The Book of the 45 Mornings," by Rudyard Kipling, author's edition; "Text-Book of Comparative Anatomy," by Dr. Arnold Lang, professor of zoölogy in the University of Zurich, translated by Henry M. Bernard and Matilda Bernard; "Euclid for Beginners," being an introduction to the existing text-books, by the Rev. J. B. Lock; Lock and Scott's American edition of the "Arithmetic for Schools;" "From Charing Cross to St. Paul's," by Justin McCarthy; "The Greek World under Roman Sway," forming a sequel to "Greek Life and Thought," and "A History of Greek Literature," by Rev. J. P. Mahaffy; "Manual of Logarithms," by G. F. Matthews; "History of Chemistry," by Professor Ernst von Meyer, translated by Dr. George McGowan; "Story of the Greek Tragedians," by Dr. Munk, translated by A. W. Verrall; "Outlines of General Chemistry," by Professor Ostwald, translated by Dr. James Walker; "Lessons in Elementary Biology," by T. Jeffery Parker; "Chronological Outlines of English Literature," by F. Ryland; "The Fossil Insects of North America," by Dr. Samuel H. Scudder; "Dr. Schliemann's Excavations at Troy, Tiryns, Mycenæ, Orchomenos, Ithaca, presented in the Light of Recent Knowledge," by Dr. Carl Shuchhardt, translated by Miss Eugenie Sellers; "The Myology of the Raven (*Corvus corax Sinuatus*): A Guide to the Study of the Muscular System in Birds," by R. W. Shufeldt; "Elements of Politics," by Henry Sidgwick; "A Geography of Europe," by James Sime; "A Hand-Book of Phonetics," by Miss Soames; "Practical Physics," Vol. III. "Optics, Heat, and Sound," by Balfour Stewart and W. W. H. Gee; "The Royal House of Stuart, illustrated by a Series of Forty Plates in Colors, drawn from the Relics of the Stuarts," by William Gibb, with an introduction and notes by John Skelton; "Analysis of English History," based on Green's "Short History of the English People," by C. W. A. Tait; "The Histories," edited with introduction and commentary, by the Rev. W. A. Spooner, M.A.; and "A System of Sight-Singing from the Established Musical Notation," based on the principle of tonic relation, and illustrated by extracts from the works of the great masters, by Sedley Taylor, author of "Sound and Music," etc.

EFFORTS are being made in Sweden for the wider circulation of the observations from the Meteorological Office. The observations are telephoned to about thirty-five places, whence they are signalled by flags, a yellow, a blue, and a red, in accordance with a signalling code, which is distributed free of cost. A number of steamers have also undertaken to carry these signalling flags, and at a number of railway stations the signals are hoisted. There are even some trains that carry them.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

PROFESSOR W. M. DAVIS, Harvard College, Cambridge, Mass., desires to correspond with professional and amateur photographers, from whom he can obtain views of New England landscapes

WANTED.—A specialist in chemistry (an American) desires a position as instructor in chemistry; as assistant or in full charge of department; would accept a lucrative position in physical sciences; studied at Göttingen, Germany; degree Ph D.; two years' experience as teacher of chemistry. Address DOCENT, P. O. Box 1151, Brockton, Mass.

WANTED.—Advertisements of text-books and good standard works on Natural History, for stocking a library. Add price. Address M. D. SULLIVAN, St. Louis University, St. Louis, Mo.

WANTED.—Science teacher at the State Normal School, Winona, Minn. Address the President, IRWIN SHEPARD.

WANTED—Index to Vol. VIII. and a copy of No. 205 of SCIENCE. Ten cents will be paid for a copy of either of these if in good condition. Publisher of SCIENCE, 47 Lafayette Place, New York.

TO PRINCIPALS OR COMMITTEES.—Professor of Classics and Sciences, experienced in advertising and building up schools, now employed, desires change. WILLIAM, Roslyn, L. I.

WANTED.—A graduate from the Advanced Course of the Framingham State Normal School desires an assistant's position in a high school. An appointment in New England preferred. Address G., Lock Box 4, Framingham, Mass.

HYBRIDS.—A. M. Suchetet, 10 Rue Alain, Rouen, France, desires to correspond with those possessing hybrids, either living specimens or stuffed, of mammals, birds or other animals.

CHEMIST.—A Harvard Graduate and Specialist in Chemistry desires a position with some manufacturing industry, or with a practical chemist. He would make an engagement to take charge of a laboratory and lecture on Chemistry. He has had large experience in the laboratory and school-room, and can give the best of references. Address J., Harvard College, Cambridge, Mass.

WANTED.—A Lady Teacher, at present teaching in England, with 12 years of very successful experience in primary work, desires a similar position in America. An appointment in the State of Ohio, or the City of New York, preferred. Excellent references, etc. Address in July or August, L. DUNCAN, Poste Restante, Stainland, Halifax, England.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

For exchange—minerals and fossils, including ores, corals, Mazon Creek nodules for other minerals and fossils or historical relics. Tertiary specimens desirable. Address T. N. Glover, Lock Box 19, Suffern, N. Y.

I wish to exchange Riley's Missouri Reports, either singly or full set, for Proceedings Entomological Society, Philadelphia, vols. 2 to 6 inclusive. Will also exchange Casey's Revision of the *Stenini* of N. A. and Horn's Revision of the *Tenebrionidae*. F. M. Webster, La Fayette, Ind.

I wish to exchange a fresh and complete set of Weiss and Spier's "Necropolis of Ancon" for other books, either new or second-hand, if the latter are in good condition. What have you to offer? Address Warren Watson, Kansas City, Mo.

1,000 botanical specimens representing 250 genera in exchange for those not in my collection. Send list of duplicates, and receive a similar one to choose from. Address E. E. Bogue, Orwell, Ashta Co., Ohio.

For exchange—14 volumes (1883-1889) American Journal of Science, 10 volumes (1880-1889) American Naturalist, 21 volumes (1879-1890) English Mechanic, all in good condition for binding; also, Morris Typewriter. Wants first-class microscope, camera, chemical or physical apparatus. Address, with full particulars, E. R. Chadbourn, Lewiston, Maine.

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted—To furnish roots of *Dodecatheon Meadia*, *Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

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SCIENCE

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CHANGES IN COLOR OF HAIR AND FEATHERS.

THE question of change of color of the hair is an interesting one both from a physiological point of view and from the practical one of pathology. The physiological aspect embraces the question of how a change of color takes place, —whether in existing hairs, or produced by shedding of the hair and a new growth taking its place of a different color.

It has been doubted by good authority (Hebra and Kaposi) if the hair, after being once developed, can change except by a very gradual process. This doubt is based upon the theory that the hair has no vascular or nerve connection with the general system, and must therefore be independent of nervous or systemic influence. This position is, however, not tenable. The clinical evidence is positive that the hair does change color under systemic influences, sometimes gradually, and sometimes suddenly. We hear frequently of the hair turning white in a night from violent emotions, as fright, great grief, or great joy; and it has come to be a method of expressing extreme emotion to say, "It was enough to turn one's hair white." I say it is not an uncommon thing to see mention of such cases in popular literature, but well-authenticated cases are not so often found. It is recorded in history that the hair of Marie Antoinette and Mary Queen of Scots became white suddenly from the horrors to which they were subjected. Poets have not failed to avail themselves of the idea. Byron, in the "Prisoner of Chillon," says,—

> "My hair is gray, but not with years;
> Nor grew it white
> In a single night,
> As men's have grown from sudden fears."

A short time since, in conversation with an eminent microscopist and pathologist,[1] I asked how he would explain from the basis of minute anatomy the sudden change in color of the hair. He replied that he did not explain it; that he did not believe it happened; that the reported cases were not authenticated. He further said, that, from the structure of the hair and its relation to the skin, he considered it impossible.

Duhring (third edition) is authority for the statement that Hebra and Kaposi discredit sudden canities. There is nevertheless no doubt of the fact that such change does sometimes occur; and, to set the matter definitely at rest, I looked up the subject in the Library of the Surgeon-General's Office. The following are some of the references found:—

Dr. William P. Dewees[2] reports a case of puerperal convulsions under his care. From 10 A.M. to 4 P.M. fifty ounces of blood were taken. Between the time of Dr. Dewees's visits, not more than an hour, the hair anterior to the coronal suture turned white. The next day it was less light, and in four or five days was nearly its natural color. He also mentions two cases of sudden blanching from fright.

[1] Dr. Gray of the Army Medical Museum.
[2] Philadelphia Medical Museum, 1807, vol. iii. p. 219.

Dr. Robert Fowler[1] reports the case of a girl sixteen years of age, apparently in good health, hair black, who found one morning in combing her hair that a strip the whole length of the back hair was white, starting from a surface about two inches square around the occipital protuberance. Two weeks later she had patches of *Ephelis* over the whole body.

In the *Canada Journal of Medical Science*, 1882, p. 113, is reported a case of sudden canities due to business worry. The microscope showed a great many air-vesicles both in the medullary substance and between the medullary and cortical substance.

Dr. Graves[2] says most authors are of the opinion that the hair, once formed, is independent of the organism, with which opinion he disagrees, instancing *Plica polonica* as opposed to such a theory. He gives the following cases:—

1. A British officer in India, forty-eight years old, fell into bad health, and became prematurely gray. He returned to England, regained his health, and in four years his hair returned to its original brown.

2. In a man sixty-seven years of age, hair white, chest covered with long white hair, the chest was blistered; and when hair grew out over the blistered surface, it was black.

3. In a man, aged thirty-five, bald, a small blister the size of a crown piece was applied to vertex for congestion of the brain. Growth of hair followed over the blistered surface.

4. A lady, hair of vertex gray and very scanty, applied tar-water. Hair grew, and was of natural color.

5. The same occurred in another case after application of citrine ointment.

In the *Boston Medical and Surgical Journal*, 1851, is reported a case of a man thirty years old whose hair was scared white in a day by a grisly bear. He was sick in a mining camp, was left alone, and fell asleep. On waking, he found a grisly bear standing over him.

A second case is that of a man of twenty-three years who was gambling in California. He placed his entire savings of eleven hundred dollars on the turn of a card. He was under tremendous nervous excitement while the cards were being dealt. He won. The next day his hair was perfectly white.

[1] London Lancet, 1853, p. 556.
[2] Dublin Quarterly Journal of Medical Science, 1847.

In the same article is the statement that the jet-black hair of the Pacific Islanders does not turn gray gradually; but when it does turn, it is sudden, usually the result of fright or sudden emotions.

The following cases are of change of color from white to black:—

Dr. Bruley,[1] physician to the Fontainebleau, reported to the Society Médicale, Paris, in 1798, the case of a woman sixty years old, whose hair, naturally white and transparent as glass, became jet-black four days before her death (phthisis). On examination after death, the bulbs of the black hairs were of immense size and engorged with dark pigment. The roots of white hairs that remained were dried up, and two-thirds smaller in size.[2]

Dr. Alanson Abbe[2] mentions the case of Dr. Capen, who had become gray, but, on recovery from disease, his hair became quite dark.

In the *St. Louis Medical and Surgical Journal*, 1845, p. 310, there is reported the case of an old man eighty-one years of age, robust and hale. His hair, from being perfectly white, became black, and the same of the beard. This man also presented the phenomena of second sight. He could read readily without glasses. The text-books on skin-diseases also mention cases. Several cases of sudden canities are referred to in Ziemssen.

Brown-Séquard, in his own person, noticed one day a white hair in his beard where there was none the day previous. He pulled it out, and the next day others appeared. This was observed repeatedly, and there was no doubt the hair in its entire length turned white in one night. Under the microscope these white hairs showed small air-bubbles in place of the normal pigment. In a case of hemiplégia the hair became white on the paralyzed side. The same has been reported in cases of neuralgia. Other anomalous cases have been noted where the hair became white in patches, and where individual hairs have been seen alternately white and black at different stages of its growth, to which condition Karsh and Landois have given the name of "ringed hair," and ascribed it to an intermittent trophic disease affecting the hair-follicle. Wilson[3] mentions a case where the hair was gray in winter, and regained its normal color in summer.

Alibert[3] and Beizel relate cases of women with blond hair which all came out after severe fever, and when new hair grew it was black. Alibert also relates the case of a young man who lost brown hair during illness, and that which replaced it was red. In the case of an epileptic girl of idiotic type, with alternating phases of stupidity and excitement, during the stage of stupidity the hair was blond, during excitement it was red. This change of color took place in two or three days, the change always beginning at the ends of the hairs. Pale hairs showed an increased number of air-spaces. It has been frequently observed, that, when the hair changes color gradually, the change begins in the end, and extends toward the bulb. In conversation with an eminent ornithologist on the change of color in the plumage of birds, he said, "I have lately been watching hairs in my mustache turn gray, and they always begin at the ends, and it extends to the roots."

[1] Boston Medical and Surgical Journal, 1852, p. 406.

[2] Wilson, Skin Diseases, p. 377.

[3] Drocker, Diseases of the Skin, 1888.

Speaking on the subject with a lady, she mentioned the case of the physician who attended her at the seashore last summer. The doctor's hair was long and quite gray. One day he came in to see her after having his hair cut, and she was surprised to notice that the gray hair had given place to black. Examination showed that his hair towards the ends had been white, and that nearer the skin black. The white portion had been removed by the cutting.

The cases here collected are only a few in comparison to what might be found; but they are sufficient to prove beyond all reasonable doubt that the hair does suddenly change color under certain circumstances, and that the change takes place in existing hairs.

Analogous to changes in the color of the hair in man are the changes which occur in the lower animals. In animals and birds such changes are often periodical, as in their summer and winter coats. This occurs to a very marked degree in a great many species. Thus the ermine in summer is dark brown, in winter is pure white. Among birds the ptarmigan is white in winter, and brown in summer. So with our familiar bobolink, yellow in fall, in spring black and buff. As to the question whether, in birds and animals, this change takes place in individual feathers and hairs, or whether all the old plumage and fur is shed by moulting, recent investigations favor the view that it is due to both. Dr. Elliott Coues[1] says it may be either or both. Mr. Robert Ridgway (Smithsonian Institution) inclines to the opinion that in birds it is accomplished by moulting. Dr. Louis Stejneger (Smithsonian Institution) was formerly of the same opinion, but recent studies have inclined him to the belief that there is also a change in the color of existing feathers. He was led to this change of belief by a critical study of the changes in color of the black and white fly-catcher of Europe, and especially from an examination of a series of twenty-seven specimens of the narcissus fly-catcher (*Xanthophygalia narcissina*) of Japan. His studies in full will appear in the "Proceedings of the United States National Museum, 1889." Dr. C. Hart Merriam, ornithologist of the Agricultural Department, in a letter dated June 12, 1889, says, "The change from fall to spring plumage in birds is due to moult—without exception, as far as I am aware. In the case of mammals the matter is now in dispute. Probably in the majority of cases it is due in part to moult, and in part to actual change in the color of existing hairs. . . . The change in color from immaturity to maturity is always due to the growth of new hairs or feathers."

That the change in birds and mammals is due in part, at least, to change of existing coats, seems established. Sometimes this change is almost sudden, as where the change of season is very abrupt. In such case, of course, there would not be time for the growth of new hair or plumage.

In the golden plover (*Charadrius dominicus*) the black belly of summer changes to white in winter. While this change is taking place, individual feathers, part black and part white, may be seen. In Bonaparte's gull, a common gull of our coast (*Larus Philadelphia*), the black of the head of summer changes to white in winter, principally by change in color of existing feathers.

Another interesting feature of this question, as bearing on the change in the color of the hair by drugs, is the influence

[1] Fur-Bearing Animals.

of certain substances administered as food, in changing the color of tissues in some of the lower orders. In orange canaries it has come to be an established fact, that, by feeding the parent bird with a certain kind of food the active ingredient of which is cayenne pepper, the offspring will be of an orange color; and orange-colored canaries may be seen in the stores of most bird-fanciers. A food for producing orange canaries is extensively advertised by a bird-dealer in Baltimore (Bishop). It is reported that the Indians of the Amazon cause green parrots to change to yellow and red by feeding them upon the fat of a certain fish allied to the shad.[1] Dr. Merriam, in the letter previously quoted, says, "It is well known that food affects the color in birds. Red purple finches and pine grossbeaks invariably turn yellow when caged. This is due undoubtedly to the absence of some important food-element. In some of the zoölogical gardens of Europe it is the custom to send white spoonbills and flamingoes to Amsterdam Garden to be recolored. The particular food by which Mr. Westermann accomplishes this end is a secret, but it is believed to be a kind of shrimp or small crustacean which has a quantity of red pigment in its shell."

In the same direction are the changes of color in other tissues by particular foods. It has long been known that when pigs are fed on madder their bones become red. This fact has been taken advantage of by physiologists in studying the structure and development of bone. The phosphate of lime acts on the coloring matter of madder as a mordant. When given intermittently to a growing animal, the bone presents alternate rings of red and white.[2]

Darwin[3] mentions that pigs in Virginia eat the paint-root (*Lachnanthes tinctoria*), and their bones are colored pink, and it caused the hoofs of all but the black varieties to drop off. "From facts collected by Heusinger it appears that white sheep and pigs are injured by certain plants, whilst dark-colored individuals escaped. . . . On asking some farmers in Virginia how it was that all their pigs were black, he was informed that the black members of a litter were selected for raising, as they only had a chance of living."

Fleurens (1824) made use of madder for coloring the semicircular canals of pigeons, to outline the canals more distinctly (see also Ferrier on "Functions of the Brain," and the writings of Vulpin, the French physiologist). Mr. Lucas, osteologist of the National Museum, informs me that the bones of the crow are made purple by feeding on pokeberries. Ridgway says the bones of the Western fox-squirrel are red, while those of its Eastern brother are white. No cause has been assigned for the difference. See experiments by Marci Paolini in 1841 ("Specimen quorundam experimentorum de vi Rubiae ad ossa ovorumque Gallinarium putamina calcariæ coloranda," No. 1 of Miscellanii Medichi, Pamphlet Vol. 1149). He gives a very good plate of the colored skeleton of a fowl, and also of its colored egg after four months feeding *Rubia tinctorium*. He also gives references to other authorities, the most satisfactory of which is Belchior ("Philosophical Transactions," vol. ix., 1732–44), who gives an account of feeding hogs and fowls with madder-root and wheat-meal. A rooster so fed died in sixteen days, and showed the condition admirably. Other writers take up the subject after him in the same publication.

[1] Wallace's Amazon.

[2] Todd's Cyclopædia of Anatomy and Physiology, vol. iii. p. 853.

[3] Origin of Species, p. 9.

It is reported that among workers in cobalt and indigo the hair becomes blue; also, in artisans working with copper, the hair takes a greenish hue.

The color of butterflies can be changed according to the food upon which the caterpillars are fed. More remarkable still, perhaps, is the change of color in the chameleon and in many insects, according to the color of the substance with which they are in contact.

The environment undoubtedly has a powerful influence upon the coloring of animals and birds. This is clearly illustrated in every museum of natural history. Specimens from arid desert regions are uniformly of a dull appearance, compared with those from regions of luxuriant foliage.

M. G. Pouchet,[1] in his work "Mechanism of Change of Color in Fishes and Crustaceans," says that change of color in fishes is due to the size of contractile colored cells placed in the skin. These are under the influence of the nerves. The author found that the particular nerves controlling them (in the turbot) were nerves of the sympathetic system. By cutting the nerve supplying a particular area of the skin, he had been able to retain that area unchanged in color, while the rest changed as the fish found itself on a dark or light surface. That the eye is the means by which this change in its condition is communicated to the fish or crustacean, and that then reflex action takes place through the sympathetic nerves on the color-cells of the chromatophors, is proved by the fact, that, when the animal experimented on is blinded, no further change of color occurs when it is removed from light to dark or the opposite (see also *Monthly Microscopical Journal*, 1871, vol. vi., M. G. Pouchet on "Study of Connection of Nerves and Chromoblasts," principally in fishes and batrachians).

The reasons assigned by naturalists for periodical change in color of plumage or fur are twofold: (1) sexual selection; (2) as a protection against enemies.

1. Sexual selection. The male takes on a brighter and more attractive appearance to facilitate the business of courtship and the securing of a mate.

2. As a protection against enemies. In Arctic regions birds and mammals are usually white in winter, the color of the snow; so that they are with more difficulty found by their enemies. Darwin supposes that originally only a few individuals took on this change; and, these being better protected, gradually, by a process of natural selection, only the white variety was left.

It is apparent, from what has been said, that there is very much concerning the changes of color of the hair and other appendages of the skin in man and the lower animals that is not understood. In its normal condition, the color of the hair is dependent upon the hair-bulb. It is here that the melanine is secreted from the coloring-matter of the blood; and from this point, as the hair grows, it permeates its cells, the intensity and shades, from black to blond, depending principally upon the amount of the coloring-matter. In black hair the hair-bulb is larger, contains a greater amount of melanine, and the hair itself is coarser and of more vigorous growth. In those cases where the hair has turned from white to back, and minute examination has been made, this has been found true.

[1] Transactions of the British Association for the Advancement of Science, 1872, p. 152.

In the case reported by Bruley, already referred to, of a woman aged sixty, whose hair, previously white, became jet-black four days before her death, the bulbs of the black hairs are described as being of immense size and engorged with dark pigment, while the roots of the white hairs that remained were dried up and two-thirds smaller in size. So, on the other hand, in change from dark to white, the hairis finer in texture, less vigorous in growth, and the hair-bulbs smaller.

The sudden change in canities, when due to violent emotions, can be explained in no other way than through the bulb. It is true that there is no direct vascular or nerve connection between the bulb and its hair after it emerges from the skin, but it is also undoubtedly true that there is communication by osmosis between the cells of the papilla and those of the shaft and different layers of the hair.

Wilson[1] ascribes the cause of sudden whitening of hair to insufficient nutritive power of the skin, and also suggests that there may generate a gaseous fluid in the hair in place of its normal constituents. He says, further, that the fluids from the blood-vessels of the skin permeate the hair, and thus change in fluids may alter the color.

In all of the cases of sudden change to white, where the hair has been examined, the coloring-matter has disappeared, and in its place is found an accumulation of minute air-globules. The same is true of gray hair of advancing age. How the air gets into the capillary structure has never been explained. Two possible explanations are offered: one is, that in the destruction of the coloring-matter a gaseous substance may be developed; the other is, that air may find entrance from without, through the sides or end of the hair. It is possible to suppose a condition of the bulb producing a vacuum in the hair-shaft that shall cause, by suction, a drawing-in of air. The view that the air finds entrance through the end of the hair is supported in the fact that the change of color begins at the extremity.

Erector pili muscle has an important influence on pathological changes which take place in the hair-bulb. This minute muscle has its origin in the true skin, and, passing downwards, is inserted into the base of the hair-bulb; so that when it contracts it lifts the hair outwards, and compresses its papilla. The effect of sudden fright causes the hair to "stand on end" by contracting this muscle. Temperature has its influence with animals and birds. In cold weather (winter) the change is to white; in summer, to black. Cold, we know, contracts the skin, and thus probably causes pressure on the hair-bulb. That the hair is easily influenced by external causes, as well as those which come through its bulb, is fully demonstrated. The mere fact that it can be so readily dyed and bleached artificially, shows that the agents used for this purpose penetrate its substance. Bleaching-agents, such as chlorine, peroxide of hydrogen, and strong alkalies, act by removing the coloring-matter, and not by adding any whiteness of their own.

It remains to say a few words upon the subject of changing the color of the hair by substances taken internally.

1. In the human subject the only agent, as far as I am aware, which has been charged with changing the color of the hair, when taken internally, is jaborandi.

2. Cayenne-pepper food changes the color of canary-birds to orange. This is a well-known fact to bird-fanciers. I tried in Washington to get a specimen, but was told it was not the season for them, that they came in the autumn; also that they soon relapsed to their original color unless the cayenne-pepper food was kept up.

3. The change of color in parrots by the Indians of the Amazon, from green to yellow or red, is produced by feeding the fat of a certain kind of fish (Wallace's Amazon).

4. The restoration of certain birds to their original brilliant colors at the Zoölogical Garden, Amsterdam, is the result of feeding a kind of shrimp or small crustacean.

5. As analogous to the above, is the effect of madder in staining the bones of pigs red, and of poke-berries coloring crows' bones purple.

It might be of interest to study the influence of diet and habit upon the color of hair in different nations of men; as, for instance, why the Saxons have light hair, and the Gauls black hair. It is within the bounds of possibility, also, that discoveries may be made in the future by which the color of the hair in the human race may be modified by judicious treatment of the parents.

Some colors of hair are not popular, especially with ladies, and it is not likely that cayenne pepper will ever become popular to produce the orange hue; but if its antithesis should be discovered, and the orange changed to black or blond, then perhaps the gentle maiden with auburn hair will disappear, and the white horse be left in melancholy solitude.

In the *Philadelphia Medical Times* of July 2, 1881, I published a case entitled "Remarkable Change in the Color of the Hair from Light Blond to Black in a Patient while under Treatment by Pilocarpin,—Report of a Case of Pyelo-Nephritis, with unusually Prolonged Anuria." This was a case of a lady twenty-five years of age, and the drug was used to relieve the uræmic symptoms resulting from the anuria, which latter was extreme. On Dec. 16, 1880, treatment of pilocarpin hydrochlorate hypodermically was commenced, the dose given being one centigram (one-sixth of a grain). The effect of this was very prompt; and the sweating and salivation produced, most profuse. The relief to the uræmic symptoms was complete, the patient falling into a quiet sleep as soon as the effect of the drug ceased, and sleeping all night, awakening in the morning bright and refreshed. The pilocarpin was thus used twenty-two times from Dec. 16, 1880, to Feb. 22, 1881, requiring thirty-five or forty centigrams. As the patient became accustomed to the medicine, it was found necessary to give two centigrams at a dose. After Feb. 22 she began to improve, and no more was required. All her life up to November, 1880, the hair was a light blond. Four specimens of the hair were sent to the editor of the *Philadelphia Medical Times*, with the report of the case, for his inspection, and were as follows: (1) November, 1879; (2) November, 1880 (on this and the preceding date the color was the same, a light blond, with tinge of yellow); (3) Jan. 12, 1881, a chestnut-brown; and (4) May 1, 1881, almost a pure black. The growth of hair was also more vigorous, and individual hairs thicker. I believed at the time, and still believe, that this change of color was caused by the pilocarpin. The lady is still, at this date (March 10, 1889), under my observation. Her hair is now dark brown, having returned to that color from black. The full report of this case can be found in the *Philadelphia Medical Times* for July 2, 1881.

[1] Lecture on Skin.

The following case is reported as adding another to the evidence that jaborandi will produce the effect mentioned under favorable circumstances. Mrs. L., aged seventy-two years, was suffering from Bright's disease (contracted kidney). Her hair and eyebrows have been snow-white for twenty years. She suffered greatly from itching of the skin, due to the uræmia of the kidney-disease; skin harsh and dry. For this symptom fluid extract of jaborandi was prescribed, with the effect of relieving the itching. It was taken in doses of twenty or thirty drops several times a day, from October, 1886, to February, 1888. During the fall of 1887, it was noticed by the nurse that the eyebrows were growing darker, and that the hair of the head was darker in patches. These patches and the eyebrows continued to become darker, until at the time of her death they were quite black, the black tufts on the head presenting a very curious appearance among the silver-white hair surrounding them.

At the time the first of these cases was reported, the facts as stated were received with considerable incredulity, the editor of one well-known Western medical journal openly refusing them credit. Others preferred the charge that the lady had formerly bleached her hair, and that when this was no longer possible her hair returned to its original color. In reply to these "suggestions," I will only say that the facts are known to scores of people at her home in Washington, D.C., and are entirely beyond question.

As illustrating the ubiquity of the daily press, and the ease with which all sorts of nostrums, valueless or otherwise, may be brought into notice through the newspapers, and how easy it is to make such a matter profitable to the advertiser, I mention an incident in connection with the case just reported.

It seems that some enterprising newspaper-man became cognizant of the case, and put a short notice in a New York daily paper to the effect that a drug had been discovered that would turn white hair black, and make hair grow on bald heads, giving my name as being connected with the Smithsonian Institution. This paragraph must have been extensively copied in newspapers both throughout this country and abroad. The first intimation I had of its existence was an avalanche of letters from all parts of the country wanting information, some offering money for the receipt, others enclosing money in advance; which latter, be it known, I at once returned. One from London, England, enclosed the half of a two-dollar bill, with the information that the other half would be speedily forthcoming on receipt of the formula or medicine.

These are the only cases thus far reported in which pilocarpin has been supposed to change the color of the hair.

In 1879 Dr. G. Schmitz[1] of Cologne reported two cases in which pilocarpin stimulated the growth of the hair in alopecia. One patient, aged sixty, was completely bald. Pilocarpin was injected subcutaneously for disease of the eye. After three injections, within a fortnight the head became covered with a thick down, which grew rapidly, so that in four months no trace of the baldness was left. No mention is made of the color. In the second case the patient, aged thirty-four, had a bald patch on top of the head the size of a playing-card. There was total restoration of the hair after two injections, in a short time.

[1] Berliner Klinische Wochenschrift, No. 4, 1879; Medical Bulletin, Philadelphia, 1882.

Schöller[1] tells of similar results in animals in which alopecia had been produced by injections of bacteria.

Oscar Simon[2] relates the case of a woman, aged thirty, who had general baldness,—head, eyebrows, eyelashes. In a few weeks, after twenty injections of pilocarpin, the hair of the whole body was restored. In other cases so treated there was no effect whatever.

Landesberg[3] of Philadelphia says that in more than a hundred cases of eye-disease treated by pilocarpin he observed no effect whatever upon the growth of the hair. The dose and mode of administration are not mentioned.

In 1882 Julius Pohlman[4] experimented on white rabbits by hypodermic injections of pilocarpin. The dose used was large,—one grain three times a day. No change in color was noted in pure white rabbits. In party-colored animals, white and brown, in one a brown spot on the back of the head deepened, and spread to a remarkable degree down the back and sides of the animal to the legs. In other individuals no change was noticed. Post-mortems in these animals showed enlarged spleen and altered suprarenal capsules.

D. W. PRENTISS.

POISONING BY MUSSELS.

IN the *Lancet*, July 26, 1890, Sir Charles A. Cameron of Dublin says, "On June 30, Mrs. O'Connor, her five young children, and her maid-servant, residing at Seapoint, County Dublin, partook of a meal of stewed mussels. In about twenty minutes after the ingestion of the mussels, some of the children stated that they felt a prickly ('pins and-needles') pain in their hands. Graver symptoms rapidly supervened, and in less than an hour one of the children died, the mother and three other children succumbing within two hours after eating the mussels. The chief symptoms were vomiting, dyspnœa, swelling of the face, want of co-ordination in movement, and spasms, principally in the arms. The patients appeared to have died asphyxiated, their faces being intensely livid. One of the children and the maid (the latter had eaten but few of the mussels) suffered very much, but recovered. Medical assistance came rather late, and was not of much use. The mussels had been procured from a small sheet of water to which the sea had access, but which received fresh water and some sewage. Examinations of the water at low and high tides showed that its saltness was twice as great when the tide was in,—a proof that land water drained into it when the tide was out. This land drainage would necessarily, from local conditions, be impure.

"It was deemed necessary for judicial purposes, that the cooked mussels, and the matters vomited by the patients, should be examined for ordinary poisons. This was done, with negative results. The uncooked mussels, compared with mussels of the same size from the open sea, appeared to have much larger livers, and their shells were very brittle. An attempt to extract an alkaloid was made. The generic tests applied, clearly proved the existence of a leucomaine, which, indeed, was obtained in crystals visible under the microscope, and corresponded to those described by Brieger as existing in the poisonous mussels which he examined. The quantity of material available did not, however, yield a sufficient quantity of the leucomaine for a thorough examination. I have procured a supply of mussels from the pond in which the poisonous mussels were found, and hope to be able to extract from them a substantial quantity of the leucomaine, which will probably be found identical with Brieger's mytilotoxine ($C_6H_{15}NO_2$). The mussels are mixed with mud having an offensive odor.

"The Seapoint case is another instance of poisonous mussels be-

[1] Klebs's Archiv, 1879.
[2] Berliner Klinische Wochenschrift, 1879.
[3] Medical Bulletin, Philadelphia, 1882.
[4] Buffalo Medical and Surgical Journal, 1882, p. 441.

ing procured from foul or stagnant water. In this case the opinion of M. Dutertre, that the liver of poisonous mussels is the seat of disease and the generator of the poisonous leucomaine, seems confirmed; but I cannot agree with the French observer, that the disease is never the result of the poisonous nature of the food of the mussel. I have read all, or nearly all, the cases of mussel-poisoning on record, and I gather from such details as are given with respect to the places in which the mussels were found that they were in contact with sewage or stagnant water."

RECENT THEORIES OF GEOMETRICAL ISOMERISM.[1]

THE histologist places a section of organized tissue upon the stage of his microscope, and studies its structure. He reports upon the cells and their contents, for he has seen them, but he has not detected the molecule. The smallest discernible particle was probably an aggregate of at least a million molecules of elaborate structure, permeated by many times as many molecules of simpler composition.

The actual configuration of atoms in the molecule, the bonds by which they are united, the mechanism which effects transformations from one form to another, and, indeed, the very existence of molecules, are subjects which do not belong to the world of sight. It is not likely that any human eye, with the most perfect optical instruments, will ever penetrate these secrets of an unseen world.

But the many unseen worlds are favorite hunting-grounds of science. The imagination of the geologist sees successive strata in regular order or thrown into folds, where the rocks are hidden from the uninitiated by drift, soil, and forest, or even where they were long since removed by erosion. The astronomer, having discovered a simple law controlling the motions of the planets, pursues them with the formulas of dynamics and perturbations, until the unexplained residuals of motion lead him to the very spot occupied by Neptune. The biologist experiments upon the vitality of invisible germs, but the chemist reasons upon the elements that make up molecules of which these germs consist. He recognizes atoms having simple, double, triple, and quadruple power of union. Whatever be the nature of this union, the "bonds" are as real as ever held prisoner to Roman soldier. The structural formulas which characterize the language of modern chemistry express the fact that each atom is specially related to a certain one or more other atoms, with scarcely the least claim in regard to distance or direction.

The doctrine of valence and types prepared the way for the more elaborate doctrines embodied in structural formulas, which so admirably explain numerous re-actions and isomers. Such is our ignorance of the actual relations of the atoms in space, that no photographs of geometrical isomers can be offered for inspection; yet certain working hypotheses of their configuration, which were received for some years with great reserve, have recently had such influence in shaping the current of research in organic chemistry, that they are well worth our attention at this hour.

When the quadrivalent character of carbon was distinctly recognized, as in CH_4, it was probably not long before the regular tetrahedron often occurred to thinking minds as a suitable representation. If CH_4 thus represents the outline of a regular tetrahedron, it must not be supposed that the actual form is changeless, but rather that the mean positions of the hydrogen atoms are at the angles. In substitution products, we may think of the several radicles oscillating about mean positions that are at unequal distances from each other, the mutual attraction of the most unlike groups bringing them somewhat towards each other. The conditions in the two forms (see below) are so far identical that the mean mutual distance of any pair of groups will be the same in both. The difference would not be likely to make one form more easily soluble or volatile than the other. The usual means of distinguishing isomers may fail. Ordinary methods of fractional distillation or precipitation are alike useless to distinguish tweedledum and tweedledee. A most delicate instrument, capable of feeling the slightest resistance to the vibrations of luminiferous ether, is found in a ray of polarized light. When such a ray passes through the asymmetric molecule, it is probable that greater resistance will be met in some one plane than in another, and thus the plane of polarization is slightly turned. In a fluid aggregate, a ray will meet successive molecules in all possible positions; and while these must have unequal effects,—sometimes, perhaps, in opposite directions,—the mean result for a large number will always be the same.

Le Bel and van't Hoff were the first to state clearly (and independently) the fundamental principles upon which this branch of chemical investigation has been developed. In the first place, when carbon is linked with four different radicles, two isomers will usually result, the forms of the molecule being related to each other as an object to its image in a plane mirror. These isomers closely resemble each other in most physical and chemical properties. Two such atoms may be represented by tetrahedrons, united at the corners, where it is important to note the cyclical order of the radicles attached to each carbon atom as seen from that atom itself.

Our theory must conform, however, to the observed facts; otherwise we may either be overwhelmed with a multitude of imaginary isomers, or we may be unable to account for all that are discovered. The following principle (which has been known as "van't Hoff's second hypothesis") is supported by many facts: When two atoms of carbon are united by a single bond, each is capable of free rotation in either direction about the common axis; and isomers may be recognized for those bodies only which cannot be brought into the same configuration by such rotation. But some apparent exceptions must not be ignored, especially a marked exception to the principle of free rotation, announced two years ago by Auwers and V. Meyer.

Again, using the tetrahedron as the symbol of the carbon atom, we may conceive two such forms united on a common edge, with hydrogen at the four free corners, to represent the molecule of ethylene (C_2H_4). In like manner, acetylene derivatives may be represented by two tetrahedrons with a common face.

Finally the theory of rings was discussed. A campaign is thus being conducted towards the stronghold of atomic mysteries.

The current theories of stereochemistry or geometrical isomerism are based upon those residuals of observed facts that find no explanation in the usual doctrine of structural formulas. Any complete bibliography, covering all the experimental evidence that may bear upon this subject, must therefore include all re-actions or properties that aid us in determining the constitution of the many compounds capable of appearing in geometrical isomers. In the list appended to Professor Warder's paper an attempt is made to include those papers only that may be most useful to chemists or physicists desiring to acquaint themselves with the history of the stereochemical conception, its originators, supporters, and opposers. The full value of Professor Warder's paper cannot be appreciated without the use of the many diagrams which are not available for our use.

[1] Abstract of an address before the American Association for the Advancement of Science, by Robert B. Warder, vice-president of Section C.

NOTES AND NEWS.

THE pressure of natural-gas wells in Indiana and Ohio is steadily diminishing, the diminution having already amounted to between 30 and 40 per cent. Professor Orton urges the imperative necessity of cities and States taking action to restrict wasteful use of gas; but even the strictest regulations, he says, cannot prevent the exhaustion of the supply in a few years. In this connection, says the *Engineering and Mining Journal*, it is interesting to note that the Pennsylvania Company has taken the step of refusing to sell natural gas in Erie, Penn., except by metre, charging 22½ cents per 1,000 cubic feet, in order to prevent waste of the gas. No factories are to be furnished at any point on its line, as all the gas will be used for domestic purposes.

—The American Folk-Lore Society will hold its annual meeting in New York City on Nov. 28 and 29, these dates being the Friday and Saturday following Thanksgiving Day. The sessions will be held at Columbia College, in rooms kindly placed at the disposition of the society by President Low. Last year the annual

meeting was held in Philadelphia, and was signalized by a large attendance and the formation of a local chapter of the national society, which has held meetings monthly throughout the winter. It is hoped that all persons interested in folk-lore will consider themselves invited to attend the meetings at Columbia College, when several interesting papers will be read, and that many will unite with the national society, as an increase in membership in New York and Brooklyn is desirable. The officers of the society for 1890 are as follows: president, Dr. Daniel G. Brinton (Philadelphia, Penn.); council, Hubert Howe Bancroft (San Francisco, Cal.), Franz Boas (Worcester, Mass.), H. Carrington Bolton (New York, N.Y.), Thomas Frederick Crane (Ithaca, N.Y.), Alice C. Fletcher (Nez Percés Agency, Idaho), Victor Guilloû (Philadelphia, Penn.), Horatio Hale (Clinton, Ont.), Mary Hemenway (Boston, Mass.), Henry W. Henshaw (Washington, D.C.), Thomas Wentworth Higginson (Cambridge, Mass.), William Preston Johnston (New Orleans, La.), Charles G. Leland (London, England), Otis T. Mason (Washington, D.C.); secretary, W. W. Newell (Cambridge, Mass.); treasurer, Henry Phillips, jun. (Philadelphia, Penn.). The society publishes the *Journal of American Folk-Lore*, a quarterly in octavo, bearing the imprint of Houghton, Mifflin, & Co. It is sent free to members. The membership fee is three dollars per annum. Persons desiring to join the society, or to receive the circular containing the particulars of the meeting, should address Dr. H. Carrington Bolton, University Club, New York City.

— Up till quite lately, says *Engineering* of Sept. 19, the whole of the guns for the Belgian Army were obtained from Essen; but, in the presence of the immense progress of the Belgian steel industries, it was only to be expected that an attempt would be made to change this state of affairs. A number of cannon were accordingly designed by the officers of the Belgian artillery, and manufactured in the Royal Foundry, Liége, from steel obtained from the Cockerill Company. Comparative tests of these guns and a number of Krupp guns of similar type were arranged, and have just been brought to a successful conclusion. In the first series of trials in which the ballistic qualities were to be tested, the guns selected had in each case a caliber of 5.9 inches; and a mortar, a howitzer, and a cannon of foreign and of domestic manufacture were selected. The Belgian mortar was 45 inches long, and weighed 8.2 hundredweight; while the corresponding Krupp gun was 37.4 inches long, and weighed 7.1 hundredweight. The Belgian howitzer was 83 inches long, and the Krupp 70.8 inches, whilst the dimensions of the cannons were more nearly equal. Both sets of guns were fired with the same charges, though these were above the proper limit for the Krupp guns, which must have been at a disadvantage in consequence. As was only to be expected under the conditions, the native-made guns gave somewhat better results, the ranges of the mortars and howitzers exceeding those of the Krupp guns by from 250 to 200 yards. The results with the cannon were practically identical.

—Experiments made at the Ohio Experiment Station for the past three years indicate that the plum curculio can be kept in check by spraying with Paris green or London purple in water solution. But, while this remedy was applicable to apples and plums, it could not safely be applied to peaches, because the foliage of the latter is so easily injured by the poison. Professor Bailey of the Cornell University station has been experimenting in spraying peaches this year, and in a bulletin just issued announces the following summary of his results: 1. Peach-trees are very susceptible to injury from arsenical sprays; 2. London purple is much more harmful to peach-trees than Paris green, and it should never be used upon them in any manner; 3. Injury is more liable to occur upon full-grown foliage and hardened shoots than upon young foliage and soft shoots; 4. The immunity of the young growth is due to its waxy covering; 5. Injury late in the season is more apparent than early in the season, because of the cessation of growth; 6. Injury from the use of London purple may be permanent and irreparable; 7. The length of time which the poison has been mixed appears to exercise no influence; 8. London purple contains much soluble arsenic (in some samples nearly 40 per cent), and this arsenic is the cause of injury to peach foliage; 9. A coarse spray appears to be more injurious than a fine one; 10. A rain following the application does not appear to augment the injury; 11. Meteorological conditions do not appear to influence results; 12. Spraying the peach with water in a bright and hot day does not scorch the foliage; 13. Paris green, in a fine spray, at the rate of one pound to 300 gallons of water, did not injure the trees. Probably one pound to 350 gallons is always safe.

—The following is a list in brief, according to *Nature*, of subjects on which the Dutch Society of Sciences at Haarlem invite research: a history of the mathematical and physical sciences in Holland; isomorphism; minerals in the river and dune sands on the Dutch coast; the accessory sexual glands in mammalia; heat liberated in solution of various salts in water; decomposition of water or other liquids by disruptive electric discharges within or on the surface; influence of compression in different directions on specific inductive power; determination of the form and position of the reticular micrometers used by Lacaille at the Cape of Good Hope; influence of volume of molecules on pressure of a gas; relation between density and chemical composition of transparent bodies, and the index of refraction; modification of reflected light by magnetization of some other metal than iron; methods of obtaining and fixing new varieties in cultivated plants; *rôle* of bacteria in filtration of potable waters through a layer of sand; bacteria and azotized combinations in the soil; healing after grafting.

—The last number of the *Kew Bulletin* contains a note on the properties and uses of the jarrah-wood, a species of eucalyptus native to western Australia. The main difficulties in connection with its use in this country are the cost of freight for such heavy timber from Australia, and its intense hardness, which makes it difficult, for ordinary English carpenters' tools, to work it. The tree which produces it grows generally to a height of a hundred feet, and sometimes a hundred and fifty feet. It is found only in western Australia, extending over the greater portion of the country from the Moore River to King George's Sound, forming mainly the forests of these tracts. According to Baron Mueller, when selected from hilly localities, cut while the sap is least active, and subsequently carefully dried, it proves impervious to the borings of insects. Vessels constructed solely of it have, after twenty-five years' constant service, remained perfectly sound, although not coppered.

—The steel-armor tests at Annapolis—the first armor-plate tests ever made in this country—were completed on Monday, Sept. 22. The plates used were one of solid steel with about 0.33 per cent of carbon; and the other of the composition known as nickel steel, being mild steel with 5 per cent of nickel; and a plate of a compound of steel and iron, under the Wilson patent. The plates were set side by side, and were backed with 36 inches of oak. The gun used on the first series of tests was a 6-inch rifle, 17 feet and a half in length. It was set with its muzzle 30 feet from the plates, and was mounted on a carriage, so that it could be turned to point squarely against any part of either plate. The projectiles were Holtzer chrome steel shells, 17 inches long, 6 inches in diameter, and weighing 100 pounds. The firing charge was 44½ pounds of cocoa-powder. The initial velocity was about 2,075 feet per second, giving a muzzle energy of 3,342,876 foot tons. Four shots were fired at each plate. Each plate was four feet high and 6 feet wide, and 10.5 inches thick. On Sept. 22 the tests were concluded by a shot at each plate with an 8-inch rifle firing an armor-piercing projectile. The projectile weighed 210 pounds, and was fired by a charge of 85 pounds of powder, giving an initial velocity of 1,850 feet per second. It appears from these tests, says *Engineering News*, that the solid steel armor is far superior to the compound armor having a hard steel face and a wrought iron back, when tested with modern high-power guns using armor-piercing projectiles. As regards the relative efficiency of the steel plate and the nickel-steel plate, the latter must be conceded to have proved, on the whole, the better defence, as it was not cracked by the 8-inch shot in the centre, as was the all steel plate. On the other hand, the penetration of the all steel plate was in almost every case less than that of the nickel steel, thus showing the latter to be somewhat softer and tougher than the former.

SCIENCE:

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

THE STUDY OF FOLK-LORE.[1]

THE term "folk-lore" seems to many persons to cover a field of study not clearly defined; but this quality of indefiniteness is common to all terms used to denote studies connected with the intelligence of man. "Anthropology," "ethnology," "psychology," are each terms embracing a vague and infinitely extended field, which, in practice, is limited by more or less arbitrary boundaries.

By "folk lore" is to be understood oral tradition,—information and belief handed down from generation to generation without the use of writing. There are reasons why the mass of knowledge (including history, theology, and romance) which has been orally preserved in any people should be set aside as capable of independent treatment. Such matter must express the common opinion, or it would not be remembered; it must be on a level with the notions of the average rather than of the exceptional person; it must belong, that is, to the *folk* rather than to individuals.

The term "folk-lore" has its most definite significance in connection with civilized peoples of modern Europe, having been invented by an anonymous correspondent of the London *Athenæum* (Aug. 22, 1846), who signed his name Ambrose Merton, understood to be a pseudonyme for W. J. Thoms. He included under this title "manners, customs, observances, superstitions, ballads, proverbs," and claimed the honor of introducing into the language the word "folk lore," as Disraeli had claimed the honor of "fatherland." The latter word has not met with success; but "folk-lore" has been accepted not only in English speech, but also in most European languages.

It was soon evident that the oral traditions of Europe could not be treated by themselves without consideration of oral traditions in other parts of the globe. Customs and superstitions found in the United States, for example, not only among recent immigrants, but also in families of the purest English stock, have evident connection with practices and beliefs widely extended among savage tribes. It was therefore necessary to extend the term "folk-lore" so as to cover these. There was some protest against these, inasmuch as the name "folk" belongs properly to races in which isolated tribes have been amalgamated into something resembling a nation; but this difficulty could not be allowed to prevent a convenient inclusion. So the expression came to be used, first in a definite sense, as including tales, beliefs, and practices now retained among the unlettered peasantry of Europe; second, with a wider connotation, as embracing traditionary tales, customs, and usages of uncivilized races. In its broader meaning, therefore, folk-lore is a part of anthropology and ethnography, embracing the mental side of primitive life, with especial reference to the narratives in which beliefs and habits are related or accounted for.

The subject has two sides,—the æsthetic or literary aspect, and the scientific aspect. Remarks were made on folk-lore from each of these points of view.

In treating of the literary side of folk-lore, the lecturer took his illustration from English ballads. The character of the ballad as a dance-song (late Latin *ballare*, "to dance") was pointed out, and it was shown that dancing in couples, as a mere mode of motion, was comparatively modern. According to more ancient usage, a dance was a dramatic performance, setting forth a story, which was related in a song serving to guide the movement. An illustration of this custom was still to be seen in the 'ring-games" of children. The date of collection of English ballads, and the periods of their composition, formed the theme of observations. It was shown that the circumstance of the late recording of many ancient ballads in Scotland had led to the erroneous supposition that Scotland had possessed a distinctively national song, unlike that of England; the fact being that so called Scottish ballads were only dialectic survivals of songs formerly common to all parts of Great Britain. For the origin of these compositions it is necessary to look beyond the limits of English speech; mediæval ballads not being the property of any one European country, but in a measure a common stock.

The qualities which rendered these songs of interest were remarked on, and popularity, simplicity, and antiquity were named as constituting the charm of the ballad. What has been repeated for centuries, has passed from lip to lip, and formed the joy of all classes, must stand on a different level from sentences penned for a chosen few. Ballads show that there was a period in which the mediæval noble and the mediæval serf stood nearly on the same intellectual level. These compositions serve as a perpetual lesson of simplicity, and will always be of value to bring literature back to that character of naturalness and simplicity in which true art must consist.

Proceeding to treat of the scientific side of the study, an example of a surviving American superstition was cited in the practice still in use in certain parts of the country to charm rats away from houses by writing letters to them. A specimen of such a letter was read, for the accuracy of which the lecturer could vouch, the district being the seacoast of Maine. It was shown that this method of ridding a house of rats was also occasionally used in Maryland. Comparisons from Scottish folk lore showed that the superstition was spread throughout the English-speaking world. The custom was also shown to prevail widely in France, and its origin traced to the mediæval practice of addressing legal citations and ecclesiastical admonitions to animals.

Following out the subject into the belief of savage tribes, the underlying principle was shown to be a doctrine respecting the identity of animal and human existence. In uncivilized races,

[1] Abstract of an address to the New York Academy of Sciences, March 24, 1890, by William Wells Newell, secretary of the American Folk-Lore Society.

animals are supposed to be actuated by the same motives as men, and their communities to be organized according to the rules of ethics that prevail in human society. Examples of the relation of animals and mankind were taken from the religious medicine of the Cherokees. Finally an account was given of the universal belief that animals can assume the human form, and appear at pleasure in that manner. In this manner it was made to appear that no account could be given of the American superstition without examining the character of primitive belief.

Finally the great psychological importance of the collection of folk-lore, and the necessity of immediate effort to preserve a record of it in this country, were dwelt upon. As the secretary of the American Folk-Lore Society, the lecturer presented the claims of that body, and expressed a hope that steps would be taken to increase interest in the study in New York, and to obtain more general co-operation in the important task lying before collectors and special students.

HEALTH MATTERS.

Improved Sanitation in London.

DR. B. W. RICHARDSON, in his abridgment of "The Health of Nations," gives a comparison of mortality in the Elizabethan and Victorian eras: "According to John Graunt's reports, from the parish registers, the condition of the whole city of London in the time of Queen Elizabeth was very much that of a 'slum.' The death rate was, in fact, that of a slum (it was more than 40 per thousand); but now, under some advance towards unity and centralization, it is about 20 per thousand, still including upwards of one-third of preventable deaths. The death rate then largely exceeded the birth-rate, while now the reverse is the case. The death-rate of the children under five years was then one third, or 33 per hundred: it is now 27 per hundred, and grievously too heavy. The deaths from old age, or the age then called old, of seventy, were 7 per cent: they are now sadly too low, but even in the city proper they are 18 per cent. As to personal security, John Graunt boasted that not more than one in two thousand was then murdered annually, which he ascribes to good local government. At the same rate now, murders in the whole of the metropolis should amount to no less than 2,500 annually, whereas they actually amount to an average of no more than 12 for the whole five millions of population,—a population which approaches to that of the whole kingdom of England and Wales in the time of Elizabeth."

Removal of Micro-Organisms from Water.

Dr. Krüger, considering the fact that more bacteria are usually present in rivers than in lakes, notwithstanding that lakes themselves in many cases are more or less polluted by rivers passing through populous towns, believes that this rapid decrease in the number of organisms may very possibly be due in part to the action of direct sunlight, but in the main to the tendency of water in a comparatively undisturbed state to deposit and precipitate. He therefore carried out a number of experiments with a view to determine how far the removal of organisms was brought about by the mere mechanical deposition of inert matter, and also by precipitation as a result of chemical action. The mechanical precipitants employed, all in a state of fine powder and sterilized, were alumina, brick-dust, clay, chalk, sand, coke, and charcoal. Water obtained from an ordinary service-pipe was impregnated with a liquid containing a bacillus growth of a species incident to tap-water. This was divided into two portions,—one for precipitation with the inert substance, and the other was untreated for the sake of comparison. Experiments were similarly carried out in which precipitation was obtained as a result of chemical action such as is brought about by the addition to the water, containing naturally lime, magnesia, etc., substances like wood-ash, sulphate of alumina, and slaked lime. The general conclusion come to by the author from the results obtained, as we learn from the *Medical Record* of Sept. 27, is that undoubtedly large numbers of bacteria are carried down by inert substances merely sinking in the water, but that the action is very considerably increased when, in addition to mechanical deposition, a chemical precipitation also takes place. The corollary is evident,—inert substances do mechanically assist in the precipitation of micro organisms, but preference should be given to chemical treatments.

Why He renounced Vegetarianism.

Dr. Alanus, the former leader of the vegetarians in Germany, has renounced his faith, and resumed the use of animal food, says the *Medical Record* of Sept. 27. In a letter written to a local paper, he gives the reasons for his apostacy. He had lived for a long time, he said, on a purely vegetable diet without experiencing any ill effects, feeling no worse and no better than he had formerly while living as the rest of mankind. One day, however, he found that his arteries were apparently becoming atheromatous. He was unable to account for this, as he was not a drinking man, and was still under forty years of age. Finally he came across a statement by Monin, to the effect that abstinence from animal food was a fertile cause of atheroma. He could hardly have been much of a student of dietetics not to have come across that theory until his own arteries had become diseased. There is nothing like taking comfort out of every thing, however; and he now consoles himself with the remark that he has "become richer by one experience, which has shown me that one single brutal fact can knock down the most beautiful theoretical building."

Is Cancer Contagious too?

The fact that certain spots constitute apparent foci for the spread of cancerous disease has ere now been noted, though we are still completely in the dark as to the causes which underlie these vagaries of distribution. It is, however, only by systematic close observation that we can hope to solve the enigma, and acquire the knowledge which alone will enable us to check the ravages of a terrible and implacable disease. Some observations made by Dr. Arnaudet in the little village of Saint Sylvestre-de-Cormeilles, in Normandy, are interesting in this respect. The village, according to the *Medical Press*, only numbers some four hundred inhabitants, but among them the deaths from cancer are four times more numerous than at Paris (14.88 as compared with 4.16 per hundred deaths). In the course of his inquiry into the causes of this special mortality, Dr. Arnaudet discovered that there were certain "cancer nests" which the theory of contagion could alone explain. The water-supply of these people is drawn almost exclusively from surface ponds; but he observes that very little water is drunk, though it is used in the manufacture of cider. He shows on a chart that the malady developed itself successively along a line corresponding to the water-supply supplying the ponds, and he is evidently strongly inclined to attribute the outbreak to the water, or, secondarily, to the cider. He subsequently extended his observations to four neighboring communes, in all of which the proportion of deaths from cancer was largely in excess of the normal rate. This inequality of distribution seems to point to the existence of local causative conditions, the nature of which it is highly important to elucidate.

Treatment of Tuberculosis by the Vaccine Method.

On Nov. 19, 1889, Drs. J. Grancher and St. Martin addressed to the Académie de Médecine, Paris, a sealed packet relating to a method of treatment and preventive inoculation of tuberculosis based upon numerous experiments which they had made on rabbits. The communication made by Dr. Koch to the Berlin Congress (of which the full text was published in the *British Medical Journal* of Aug. 16), concerning the results which he has obtained in rendering guinea-pigs refractory to tuberculosis, or in curing them of advanced forms of tuberculosis, has induced MM. Grancher and St. Martin to make known their researches on the same subject earlier than they would otherwise have done. In all these experiments they chose the rabbit as the subject of inoculation and intravenous injection, because there is thus produced a tuberculosis which kills very quickly, and at an almost fixed date, with constant lesions of the liver, the spleen, and the lungs, and which defies all local treatment. Tuberculosis thus induced being always fatal, a solid basis is thus secured which allows exact appreciation of the negative or positive results of any method which tends to produce the refractory state or to cure after infection. The

method employed by MM. Grancher and St. Martin was the injection of tuberculosis cultures attenuated in various degrees, and used like the dried spinal marrow in Pasteur's treatment of rabies and hydrophobia. Nine degrees of attenuation have been obtained, the four last being such that the cultivation remained sterile. The injections were made first with the most attenuated cultivations, and then with more and more virulent ones. The authors consider that by this method they have succeeded, on the one hand, in conferring on rabbits prolonged resisting power against the most certain and the most rapid experimental tuberculosis, and, on the other hand in conferring an immunity against that disease, the duration of which remains to be determined.

A Return to Blood-Letting.

M. Crocq, who has frequently written and spoken in favor of the revival of venesection, made a powerful speech dealing with this subject at a recent meeting of the Belgian Académie de Médecine, says the *Lancet* of Aug. 9. Speaking of pneumonia, he declared his disbelief in the cause of the disease being either Friedländer's bacillus or the diplococcus of Fraenkel and Weichselbaum. Inoculation of this latter microbe, he remarked, is said to procure immunity from subsequent inoculations, which is exactly contrary to the effect of an attack of pneumonia, for it rather predisposes the subject to subsequent attacks. Again, M. Crocq injected sputum from pneumonic patients in which the diplococcus had been found, into the lungs of four rabbits, but none of them contracted pneumonia. Lastly, in a doubtful hospital case the sputum was examined, and found to contain the diplococcus, but at the post-mortem examination no pneumonia was discovered. M. Crocq has never met with any cases of contagion in pneumonia, and Finckler's cases he considers were not pneumonia at all. Moreover, Fraenkel's microbe is found in affections which are neither pneumonia nor contagious. The mortality usually reported by other observers in pneumonia varies greatly; that is to say, from 5 to 35 per cent. M. Crocq has no mortality at all. He arrests all his pneumonia cases by bleeding. Rheumatic-fever, and even puerperal metro-peritonitis, he treats in the same way. The latter, he declared (amidst tokens of dissent) can be thus cured in the great majority of cases. "Never," he went on, "have I regretted having bled a patient, though I have often been sorry that I have abstained from doing so. . . . If I were to be forbidden to bleed, I would give up the practice of medicine." He was, of course, careful to explain that blood-letting, to be of any service, must be practised intelligently, and not abused, as he fears it may again come to be after the wave of reaction has once more made it popular.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Professor Hazen and Espy's Experiments.

A CORRESPONDENT has recently called my attention to certain communications of Professor Hazen to *Science* and the *American Meteorological Journal*, in which Espy's experiments are assailed, and thus indirectly my theory of cyclones and tornadoes, and he thinks there should be a reply to them. A reply, so far as they bear upon my theory, if thought necessary, is very easy; so easy, indeed, that I had not thought it necessary. Besides, I have been desirous of avoiding an unprofitable controversy with Professor Hazen on this subject.

Inasmuch as I have never used any of the results of Espy's experiments, any attack upon these experiments does not reach me, except so far as it may bear upon the results of other great physical experimenters. It is true, I sometimes refer to this noted pioneer in meteorological advancement, as any one in this age may still refer to Kepler and Newton, and very properly, but it is not at all necessary. The formula which I have used throughout in my researches, as the basis of the physical part of my theory, and which completely covers the ground of Espy's experiments, is one given by Dr. Hann in a paper published in the *Zeitschrift* of the Austrian Meteorological Society for 1874, and translated by Professor Abbe, and republished in the "Smithsonian Report for 1877." This formula, in a somewhat different form, originated with Sir William Thomson, and has been used, and gradually brought to its present form, by Dr. Reye, Peslin, Clausius, Hann, etc., and so rests upon high authority. The physical constants in this formula have been determined by renowned experimenting physicists. They are the mechanical equivalent of a unit of heat, the specific heat of air, the latent heat of aqueous vapor, the tension of the aqueous vapor of saturated air at any given temperature, etc. From this formula have been computed the rate with which ascending dry air decreases in temperature with increase of altitude, which is 0.99° for each hundred metres, and also the same for ascending saturated air at given temperatures and altitudes. These latter are given in Table III. of the appendix of my "Popular Treatise on the Winds," etc., and range from 0.37° for a high temperature at the earth's surface, up to 0.74° for a temperature of —10° C., the values for all temperatures decreasing with increase of altitude. With these data I have illustrated, by means of the table on p. 232 of the work referred to above, how the temperature in ascending currents decreases with increase of altitude under different assumed conditions, and have shown that it is very much greater than it would be in the case of dry air, and also greater than that of the surrounding air when the lower strata become a little more warmed up than usual in comparison with the upper strata. All these results have been deduced from a formula resting upon the high authorities already mentioned, and having had its origin with Sir William Thomson less than thirty years ago. Yet Professor Hazen makes the astonishing assertion that nothing has been done since Espy's time, more than fifty years ago, and that "the profoundest calculations and speculations upon the development of energy in the free air are based upon a few experiments of the crudest sort made in a small jar."

The latent heat of aqueous vapor in the formula referred to, as determined by Regnault, may be expressed for ordinary temperatures by $r=607-708t$; but according to Hazen it should be $r=0$, for he maintains that there is no latent heat set free in condensation. With $r=0$ in the formula, instead of the numbers in the table referred to above, ranging at the earth's surface from 0.37° to 0.74°, and being still less at high altitudes, we should have for all temperatures and altitudes 0.99°; that is, the rate of decrease of temperature in all cases would be that of ascending dry air, and of course the energy upon which the cyclone or tornado depends would be much diminished. Now, if Regnault has made so great a blunder, and a cloud is thrown over his reputation by Hazen's experiments, it is for the experimenting physicists of the day to take up the matter, and not for me; for I am not an experimenter, and, if I have erred, it is in relying upon insufficient authority.

It has never been claimed, even by Espy himself, that his experiments were of a refined and accurate character, and that his results were any more than rough approximations. They have been regarded as important first steps only. Espy says, "I would not wish to be understood here as saying by implication that the numbers used in this paper are strictly correct. These numbers are introduced chiefly for the purpose of illustrating the theory." He again says with regard to his results, "The grand object, then, for which these experiments were instituted, is established beyond doubt,—that the latent caloric of vapor causes the air to occupy much more space when it is imparted to the air than when it is united with water in the form of vapor." The same is shown by Dr. Hann's formula, but the latter gives quantitative results. Espy inferred from his experiments that when dry air ascends it becomes colder about 1.25° for every hundred yards of ascent. The true amount is 1.6°. He also inferred, that, when air ascends from the earth, it will begin to form cloud when it rises about as many times one hundred yards as the temperature of the air is above the dew-point in degrees of Fahrenheit. The true number is seventy-six yards.

There is a great error in several of Hazen's papers with regard

to the amount of heat arising from compressing the air, which may be noticed here. He says (*Science*, June 27) that if air is compressed 10 inches, that is, from a barometric pressure of 30 inches to 40 inches, the temperature is increased 163°. The formula for computing this, as given by Poisson, is

$$\frac{T}{T'}=\left(\frac{p}{p'}\right)^{0.291},$$

in which T and T' are the temperatures corresponding to p and p' respectively. If we put $T'=490°$, and $p'=30$ inches, this formula gives, for $p=40$ inches, $T-490°=43°$ instead of 163° as stated above. Hazen, by his method of experimenting, was able to get a heating of the whole jar of only 4° in compressing to 10 inches, or one-third of an atmosphere. This, he says, is only about one-fortieth of the theoretical value; but it is not so much in error as that, for it is about the eleventh part of the theoretical value. But Espy, in compressing to 10 inches, obtained 36° as indicated by the rise in the gauge after explosion. The theoretical value in this case given by Poisson's formula, the temperature at which Espy operated being 64°, is 45°. This, unless Poisson's formula is erroneous, indicates that the method of getting the amount of heating from the amount of rise in the gauge after explosion, is much more accurate than that of Hazen's. WM. FERREL.

Martinsburg, W. Va., Sept. 24.

BOOK-REVIEWS.

Belief in God; its Origin, Nature, and Basis. By J. G. SCHURMAN. New York, Scribner. 16°. $1.25.

THIS book consists of a series of lectures delivered at the Andover Theological Seminary during the present year. The author's object is partly to justify the belief in God, and partly to set forth his own conception of what God is. In discussing the grounds of our belief in the Divine Existence, Professor Schurman makes some excellent points against the agnostics, but fails to present any new or conclusive argument of his own. Indeed, he admits that in his view the existence of God cannot be demonstrated, but holds it to be a necessary assumption to account for the universe. He gives a brief but philosophical sketch of the history of religion, which forms the best chapter in the book. When, however, he comes to state his own view of the nature of God, he takes a position that few theists will be inclined to adopt. His doctrine is an extreme pantheism, essentially the same as that of Spinoza,—a doctrine that denies all reality to finite things, and maintains that they are only modes or functions of God. He says, "Nothing remains for us, therefore, but to surrender the vulgar belief in the existence of a multiplicity of independent things. There *is* but one real being; and of it A and B and all existing things must be conceived as parts, moments, or functions" (p. 166). If this theory is true, it is obvious that there is no room left for human personality; and Professor Schurman's attempt to save personality can only be characterized as sophistical. We are obliged to add that some parts of the book are too dogmatic for a philosophical work, being characterized by sweeping assertions of which no proof is given or even attempted. On the whole, we cannot see that Professor Schurman has helped us any toward solving the problem of theism.

AMONG THE PUBLISHERS.

"THE Story of a Magazine," a most interesting story of the conception and growth of *The Ladies' Home Journal* of Philadelphia, with portraits and sketches of its proprietor and editor, has been prepared by that magazine in pamphlet form, and will be sent free to any who will write for a copy.

—Civilization; an Historical Review of its Elements," in two volumes, will soon be issued by S. C. Griggs & Co., Chicago. The author is Charles Morris of Philadelphia. This work promises to diverge from the course usually pursued by historians on this subject. It seeks to set forth, in clear and simple language, the evolutionary steps by which the human race has passed upward from primitive savagery to modern enlightenment, and in this way to discover the true philosophy of human progress. With this end in view, the topical method is adopted, and the facts of history are used to illustrate and embellish, rather than to form the ground-work of the structure.

—*Harper's Weekly* of Oct. 4 devotes four full pages—two of text and two of illustrations—to the recent Mississippi River improvements.

—Andrew Lang is the subject of the engraved portrait in the October *Book Buyer*. The sketch gives an idea of the personality of the man as well as of his career as an author. Rudyard Kipling, whose portrait appears also in this number, is described in an article from which one can learn a good deal about this new and brilliant writer and his books.

—Professor Darwin of Cambridge, England, a son of the world-renowned Darwin, contributes to *The Century* for October a paper of high and original value on "Meteorites and the History of Stellar Systems." A striking photograph of a nebula, in which a system like our own solar system seems to be in actual formation, accompanies this paper. "Prehistoric Cave-Dwellings" is an illustrated paper by F. T. Bickford, on the prehistoric and ruined pueblo structures in Chaco Cañon (New Mexico), the Cañon de Chelly (Arizona),—the ancient home of the most flourishing community of cave-dwellers,—and other extraordinary cave villages.

—Mr. G. J. Smith has prepared "A Synopsis of English and American Literature," which issues from the press of Ginn & Co. of Boston. It gives first a list of English authors, with the names of their principal works, and accompanied by a chronological view of contemporary history. This is followed by a list of American authors, arranged on a similar plan. The work is in no sense a history, but a mere tabular list, but as such it has some merits. Its principal fault is the exaggerated importance attached to American literature, which is accorded nearly as much space as that of England. The authors in both tables are arranged as far as possible in classes, according to the kind of literature they produced, and reference is further facilitated by two indexes.

—*Babyhood* for October contains an article on the "Common Disorders of Teething Time," which the writer, Dr. John Dorning, contends are in most cases not related to the process of teething. He exposes very strikingly some of the fallacies entertained on this subject, while giving useful hints to the mothers of teething infants. "Massage," by Dr. Sarah E. Post, is probably the first popular article that has appeared on this subject, which is attracting increased attention, especially in connection with certain disorders of infancy. The article is illustrated, and gives directions as to the various kneading motions.

—An article in *Lippincott's Magazine* for October upon "Electric Lighting," by the English scientist Sir David Salomons, will find many readers; for, though electric light has come into such general use, it is but little understood by the general public. The article treats also of electric motive power, which is as little understood as electric lighting. A thoughtful paper upon "University Extension" is from the pen of Professor Skidmore. He advocates the idea of broadening the scope of the university so that the educational advantages it affords may be extended to the masses, and holds that schools should be brought into parallelism with life, instead of serving as introductions to it. In "Book Talk," Julian Hawthorne has an essay upon Rudyard Kipling.

—"Health for Little Folks" is the title of No. 1 of the Authorized Physiological Series, just published by the American Book Company. The book is intended for use in primary schools. The method and language are such as to make the matter easily comprehended by the young people for whom it is intended. Some may ask why the subject of physiology is introduced at all in the course of study of the primary schools, and the answer is to be found in the desire of the total abstainers to inculcate their ideas about alcohol in the minds of all pupils of the public schools; and, as many a child does not pursue his schooling far, it is necessary for their purpose that the doctrine that alcohol is a poison should be inculcated while the schools still have possession of the pupil.

—A popular work on the literature of India, entitled "Hindu Literature, or The Ancient Books of India," by Mrs. Elizabeth A. Reed, will soon be issued by S. C. Griggs & Co., Chicago. This volume treats of Hindoo literature from the earliest songs of the

Aryan race to the writings of mediæval days. The author reviews the labors of Sanscrit scholars in this vast field of literature, and then gives a survey of the great Indian epics, whose character and scope are illustrated by copious extracts. Her work has elicited the cordial interest of such authorities as Professor Max Müller and Sir Monier Williams, professor of Sanscrit in Oxford University; and the latter has done her the high honor of revising the chapter on "Krishna."

—Messrs. E. & F. N. Spon announce as nearly ready, "Mining and Ore Dressing Machinery," by C. G. Warnford Lock, being a comprehensive treatise dealing with the modern practice of winning both metalliferous and non metalliferous minerals, including all the operations incidental thereto, and preparing the product for the market; and as just published "Waterways and Water Transport in Different Countries, with a Description of the Panama, Suez, Manchester, Nicaraguan, and other Canals," by J. Stephen Jeans. The purpose of this latter volume is to deal with water-transport only, and more particularly that part of water-transport which is carried on by means of artificial waterways. A good deal of attention has been given in this work to the subject of isthmian canals; and in the appendix will be found a large mass of information as to the extent of the British canal system, and the dates at which the principal canal and river navigations were executed.

—The following announcement by the D. Van Nostrand Company is made regarding their Science Series. No. 9 of the series, "Fuel," by C. William Siemens, is now out of print, but it is to be entirely rewritten and very much enlarged by Mr. Arthur V. Abbott. The additional matter will take up the subject of gas and petroleum as fuel; while the chapter on artificial fuel, by John Wornmald, will be retained, with some new matter. Tables will be added, so as to increase the value of the work to students in general. The title of the new edition of No. 57, which will be ready soon, will be "Incandescent Electric Lighting: A Practical Description of the Edison System, by L. H. Latimer, to which is added the Design and Operation of Incandescent Stations by C. J. Field, and a Paper on the Maximum Efficiency of Incandescent Lamps by John W. Howell." The same firm have in preparation a translation of Dr. Otto Dziobek's "Mathematical Theories of the Motion of the Planets."

—The *Quarterly Journal of Economics*, published for Harvard University by George H. Ellis, Boston, begins its fifth volume with the number for October. The number will contain papers by Professor A. G. Warner of Nebraska, on "Some Experiments in Behalf of the Unemployed," describing interesting experiments in the United States, Germany, and Holland; by Professor S. M. Macvane of Harvard University, on "The Discussion of Value and Wages in the Recent Great Work of Boehm-Bawerk, the Austrian economist;" by Chauncey Smith, of the Boston bar, on "A Century of Patent Law," an account of the patent law of the United States and of its working during the last hundred years; and by Henry Hudson, on "The Southern Railway and Steamship Association." In addition, there will be the usual list of recent publications on economics, and general notes and memoranda, among which is a description, by Herr Stephan Bauer of Vienna, of recent discoveries by him of unpublished material on the French economists.

—Messrs. Funk & Wagnalls send us two numbers of their series of "American Reformers." The first is a life of "Wendell Phillips the Agitator," by Carlos Martyn, and is not a good beginning of the series. It gives, indeed, a large amount of information not only about Phillips himself, but also about the anti-slavery agitation and other movements in which he was engaged, and contains many extracts from his speeches. But the author's style is full of "gush" and magniloquent expressions, such as would have been displeasing to Phillips himself, and will be equally so to every

cultivated reader. The other book. "Horace Greeley the Editor," by Francis Nicoll Zabriskie, is a better work. The author, in our opinion, has too high an estimation of his hero, yet he exposes Greeley's faults, and perhaps says a little too much about his eccentricities. On the whole, though it bears, like Mr. Martyn's work, the marks of too great baste in writing, it will serve a purpose as a popular biography of Greeley. Let us hope, however, that the authors of the remaining books of the series will all use a sober and simple style, with careful avoidance of rhetoric.

— "English Sanitary Institutions, Reviewed in their Course of Development, and in Some of their Political and Social Relations," is the title of a volume by Sir John Simon, K.C.B., which the Cassell Publishing Company announce. The book is the result of some twenty-eight years' experience and of various official relations to the business of sanitary government. The author has written for the lay as well as the professional reader, and has as far as possible avoided technicality in the expression of his views.

— The contributors to the October *Magazine of American History* present a rare combination of eminence in the scholarly world. The number opens with a paper on the "Sources and Guarantees of National Progress," by Rev. Dr. R. S. Storrs of Brooklyn. This is prefaced by a portrait of the distinguished author, and, occupying twenty-eght of the pages of this periodical, is from first to last a procession of brilliant passages, clear, forcible, suggestive, showing what principles developed the little settlements into a great nation, whose future history is as secure as the past if only that moral life remains which characterized the founders of empire on this continent. The second paper, entitled "The American Flag and John Paul Jones," is from the pen of Professor Theodore W. Dwight of the Columbia Law School, New York. "Southold and her Homes and Memories," one of Mrs. Lamb's entertaining articles, is illustrated with antique dwellings of one of the oldest towns on the continent. "The Historic Temple at New Windsor, 1783," together with a curious picture recently discovered, comes from the well-known jurist, Hon. J. O. Dykman. "About Some Public Characters in 1786," we have a readable group of extracts from the private diary of Sir Frederick Haldimand. The "General Characteristics of the French Canadian Peasantry," by Dr. Prosper Bender, furnishes much interesting data on a theme of present interest. "The Mountains and Mountaineers of Craddock's Fiction," by Milton T. Adkins; "Anecdotes of Gen. Grenville M. Dodge," by Hon. Charles Aldrich; "The Story of Roger Williams retold," by H. E. Banning; "Antiquarian Riches of Tennessee;" and the several departments of miscellany,—follow. This magazine is in close sympathy with current affairs.

— Mr. T. Wemyss Reid, the biographer of the Right Hon. W. E. Forster, has performed an equally friendly office for the late Richard Monck-Milnes (Lord Houghton). "The Life, Letters, and Friendships" of this poet will form the subject of two volumes which the Cassell Publishing Company have now in press.

— The Johns Hopkins University has issued a pamphlet on "The Study of History in Holland and Belgium," by Paul Frédericq, translated from the French by Henrietta Leonard. The same author had previously described the methods of historical teaching in England, France, and Germany, and he here endeavors to apply

what he learned in those countries to the improvement of historical teaching in his own neighborhood. The historical courses at both the Dutch and the Belgian universities are characterized as quite meagre, the subject not having been accorded due prominence by the authorities. The teaching is mainly what M. Frédéricq calls theoretical, the object being to impart historical information without any attempt at original investigation. M. Frédéricq has perhaps too low an opinion of such teaching, and lays almost the whole stress of his remarks on the need of practical courses for the study of history in its sources Some of the Belgian professors, including the author himself, have established volunteer courses of this kind; but something more effective and permanent is, in his opinion, necessary to place the study on a satisfactory basis. In Holland the state of things seems to be rather worse than in Belgium, though at the University of Amsterdam there is an important course in political geography, under the guidance of M. Kan, which extends over a period of three years.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

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CALENDAR OF SOCIETIES.

Natural Science Association of Staten Island.

Sept. 11.—Charles W. Leng, Additions to Local Lists of Coleoptera; Joseph C. Thompson, Eggs of the Snapping-Turtle; H. Baruth presented a large block of sandstone containing casts of spirifers.

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PROTOPLASM AND LIFE.

By C. F. COX. 12°. 75 cents.

The author of this book was for some years president of the New York Microscopical Society, and in this volume he sets forth his views on the spontaneous generation theory and its relation to the general theory of evolution, and on protoplasm and the cell doctrine.

THE TORNADO.

By H. A. HAZEN. 12°. $1.

Professor Hazen is one of the prominent meteorologists connected with the United States Signal Office. In this work he reviews our present information as to tornadoes, severely criticising some of the opinions held in regard to them up to this time. No one has given a more careful study to these destructive storms than has Professor Hazen, and his book will prove a decided contribution to the world's knowledge. In this book will be found a careful discussion of the important question of Tornado Insurance now attracting so much attention. Hundreds of dollars may be saved by people who are thinking of such insurance by following the principles here made plain.

THE CHEROKEES IN PRE-COLUMBIAN TIMES

By CYRUS THOMAS. 12°. $1.

Dr. Thomas in this work will reverse the usual method of dealing with prehistoric subjects; that is to say, he will commence with the earliest recorded history of the tribe as a basis, and trace the chain back step by step by the light of the mounds, traditions, and other evidence, as far as possible. He has already presented to the public some reasons for believing the Cherokees were mound-builders, but additional evidence bearing on the subject has been obtained. A more careful study of the Delaware tradition respecting the Tallegwi satisfies him that we have in the Bark Record (Walam Olum) itself proof that they were Cherokees. He thinks the mounds enable us to trace back their line of migration even beyond their residence in Ohio to the western bank of the Mississippi. The object is therefore threefold: 1. An illustration of the reverse method of dealing with prehistoric subjects; 2. Incidental proof that some of the Indians were mound-builders; 3. A study of a single tribe in the light of the mound testimony. This work will be an important contribution to the literature of the Columbian discovery which will doubtless appear during the coming two years.

Others in preparation.

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A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR. VOL. XVI. No. 401. | NEW YORK, OCTOBER 10, 1890. | SINGLE COPIES, TEN CENTS. $3.50 PER YEAR, IN ADVANCE.

THE ELECTRO-MAGNET.[1]

Introductory.

AMONG the great inventions which have originated in the lecture-room in which we are met are two of special interest to electricians,—the application of gutta-percha to the purpose of submarine telegraph-cables, and the electro-magnet. This latter invention was first publicly described from the very platform on which I stand, on May 23, 1825, by William Sturgeon, whose paper is to be found in the forty-third volume of the "Transactions of the Society of Arts." For this invention we may rightfully claim the very highest place. Electrical engineering, the latest and most vigorous offshoot of applied science, embraces many branches. The dynamo for generating electric currents, the motor for transforming their energy back into work, the arc-lamp, the electric bell, the telephone, the recent electro-magnetic machinery for coal-mining, for the separation of ore, and many other electro-mechanical contrivances, come within the purview of the electrical engineer. In every one of these, and in many more of the useful applications of electricity, the central organ is an electro-magnet. By means of this simple and familiar contrivance,—an iron core surrounded by a copper-wire coil,—mechanical actions are produced at will, at a distance, under control, by the agency of electric currents. These mechanical actions are known to vary with the mass, form, and quality of the iron core, the quantity and disposition of the copper wire wound upon it, the quantity of electric current circulating around it, the form, quality, and distance of the iron armature upon which it acts. But the laws which govern the mechanical action in relation to these various matters are by no means well known; and, indeed, several of them have long been a matter of dispute. Gradually, however, that which has been vague and indeterminate becomes clear and precise. The laws of the steady circulation of electric currents, at one time altogether obscure, were cleared up by the discovery of the famous law of Ohm. Their extension to the case of rapidly interrupted currents, such as are used in telegraphic working, was discovered by Helmholtz; while to Maxwell is due their further extension to alternating, or, as they are sometimes called, undulatory currents. All this was purely electric work. But the law of the electro-magnet was still undiscovered; the magnetic part of the problem was still buried in obscurity. The only exact reasoning about magnetism dealt with problems of another kind; it was couched in language of a misleading character; for the practical problems connected with the electro-magnet it was worse than useless,—the doctrine of two magnetic fluids distributed over the end surfaces of magnets, which, under the sanction of the great names of Coulomb, of Poisson, and of Laplace, had unfortunately become recognized as an accepted part of science, along with the law of inverse squares. How greatly the progress of electro-magnetic science has been impeded and retarded by the weight of these great names, it is impossible now to gauge. We now know that for all purposes, save only those whose value lies in the domain of abstract mathematics, the doctrine of the two magnetic fluids is false and misleading. We know that magnetism, so far from residing on the end or surface of the magnet, is a property resident throughout the mass; that the internal, not the external, magnetization is the important fact to be considered; that the so-called free magnetism on the surface is, as it were, an accidental phenomenon; that the magnet is really most highly magnetized at those parts where there is least surface magnetization; finally, that the doctrine of surface distribution of fluids is absolutely incompetent to afford a basis of calculation such as is required by the electrical engineer. He requires rules to enable him not only to predict the lifting power of a given electro-magnet, but also to guide him in designing and constructing electro-magnets of special forms suitable for the various cases that arise in his practice. He wants in one place a strong electro-magnet to hold on to its armature like a limpet to its native rock; in another case he desires a magnet having a very long range of attraction, and wants a rule to guide him to the best design; in another he wants a special form having the most rapid action attainable; in yet another he must sacrifice every thing else to attain maximum action with minimum weight. Toward the solution of such practical problems as these, the old theory of magnetism offered not the slightest aid. Its array of mathematical symbols was a mockery. It was as though an engineer asking for rules to enable him to design the cylinder and piston of an engine were confronted with receipts how to estimate the cost of painting it.

Gradually, however, new light dawned. It became customary, in spite of the mathematicians, to regard the magnetism of a magnet as something that traverses or circulates around a definite path, flowing more freely through such substances as iron than through other relatively non-magnetic materials. Analogies between the flow of electricity in an electrically conducting circuit, and the passage of magnetic lines of force through circuits possessing magnetic conductivity, forced themselves upon the minds of experimenters, and compelled a mode of thought quite other than the pre-

[1] Lecture delivered Jan. 20, 1890, by Professor Silvanus P. Thompson, before the Society of Arts, London.

viously accepted. So far back as 1821, Cumming[1] experimented on magnetic conductivity. The idea of a magnetic circuit was more or less familiar to Ritchie,[2] Sturgeon,[3] Dove,[4] Dub,[5] and De la Rive,[6] the last named of whom explicitly uses the phrase "a closed magnetic circuit." Joule[7] found the maximum power of an electro-magnet to be proportional to "the least sectional area of the entire magnetic circuit," and he considered the resistance to induction as proportional to the length of the magnetic circuit. Indeed, there are to be found scattered in Joule's writings on the subject of magnetism some five or six sentences, which, if collected together, constitute a very full statement of the whole matter. Faraday[8] considered that he had proved that each demagnetic line of force constitutes a closed curve; that the path of these closed curves depended on the magnetic conductivity of the masses disposed in proximity; that the lines of magnetic force were strictly analogous to the lines of electric flow in an electric circuit. He spoke of a magnet surrounded by air being like unto a voltaic battery immersed in water or other electrolyte. He even saw the existence of a power analogous to that of electro-motive force in electric circuits, though the name "magneto-motive force" is of more recent origin. The notion of magnetic conductivity is to be found in Maxwell's great treatise (vol. ii. p. 51), but is only briefly mentioned. Rowland,[9] in 1873, expressly adopted the reasoning and language of Faraday's method in the working-out of some new results on magnetic permeability, and pointed out that the flow of magnetic lines of force through a bar could be subjected to exact calculation. The elementary law, he says, "is similar to the law of Ohm." According to Rowland, the "magnetizing force of helix" was to be divided by the "resistance to the lines of force,"—a calculation for magnetic circuits which every electrician will recognize as precisely as Ohm's law for electric circuits. He applied the calculations to determine the permeability of certain specimens of iron, steel, and nickel. In 1882,[10] and again in 1883, Mr. R. H. M. Bosanquet[11] brought out at greater length a similar argument, employing the extremely apt term "magneto-motive force" to connote the force tending to drive the magnetic lines of induction through the "magnetic resistance," or, as it will be frequently called in these lectures, the "magnetic reluctance" of the circuit. In these papers the calculations are reduced to a system, and deal not only with the specific properties of iron, but with problems arising out of the shape of the iron. Bosanquet shows how to calculate the several resistances (or reluctances) of the separate parts of the circuit, and then add them together to obtain the total resistance (or reluctance) of the magnetic circuit.

[1] Cambridge Philosophical Transactions, April 2, 1821.
[2] Philosophical Magazine, series iii. vol. iii. p. 122.
[3] Annals of Electricity, xii. p. 217.
[4] Poggendorf's Annalen, 1833, xxix. p. 462; 1838, xliii. p. 517.
[5] Dub's Elektromagnetismus (ed. 1861), p. 401; Poggendorf's Annalen, 1853, xc. p. 440.
[6] De la Rive's Treatise on Electricity (Walker's translation), i. p. 292.
[7] Annals of Electricity, 1839, iv. p. 59; *Ibid*, 1841, v. p. 195; Scientific Papers, pp. 8, 34, 35, 36
[8] Experimental Researches, iii. arts. 3117, 3228, 3230, 3260, 3271, 3276, 3294, and 3361.
[9] Philosophical Magazine, series iv. vol. xlvi. August, 1873, "On Magnetic Permeability and the Maximum of Magnetism of Iron, Steel, and Nickel."
[10] Proceedings of the Royal Society, xxxiv. p. 445, December, 1882
[11] Philosophical Magazine, series v. vol. xv. p. 205, March, 1883, "On Magneto-Motive Force;" *Ibid*, xix. February, 1885; Proceedings of the Royal Society, 1883, No. 223; Electrician, xiv. p. 291, Feb. 14, 1885.

Prior to this, however, the principle of the magnetic circuit had been seized upon by Lord Elphinstone and Mr. Vincent, who proposed to apply it in the construction of the dynamo-electric machines. On two occasions[1] they communicated to the Royal Society the results of experiments to show that the same exciting current would evoke a larger amount of magnetism in a given iron structure if that iron structure formed a closed magnetic circuit than if it were otherwise disposed.

In recent years the notion of the magnetic circuit has been vigorously taken up by the designers of dynamo-machines, who indeed base the calculation of their designs upon this all-important principle. Having this, they need no laws of inverse squares of distances, no magnetic moments, none of the elaborate expressions for surface distribution of magnetism, none of the ancient paraphernalia of the last century. The simple law of the magnetic circuit and a knowledge of the properties of iron are practically all they need. About four years ago, much was done by Mr. Gisbert Kapp[2] and by Drs. J. and E. Hopkinson[3] in the application of these considerations to the design of dynamo-machines, which previously had been a matter of empirical practice. To this end the formulæ of Professor Forbes[4] for calculating magnetic leakage, and the researches of Professors Ayrton and Perry[5] on magnetic shunts, contributed a not unimportant share. As the result of the advances made at that time, the subject of dynamo design was reduced to an exact science.

It is the aim and object of the present course of lectures to show how the same considerations which have been applied with such great success to the subject of the design of dynamo-electric machines may be applied to the study of the electro-magnet. The theory and practice of the design and construction of electro-magnets will thus be placed, once for all, upon a rational basis. Definite rules will be laid down for the guidance of the constructor, directing him as to the proper dimensions and form of iron to be chosen, and as to the proper size and amount of copper wire to be wound upon it in order to produce any desired result.

First, however, an historical account of the invention will be given, followed by a number of general considerations respecting the uses and forms of electro-magnets. These will be followed by a discussion of the magnetic properties of iron and steel and other materials, some account being added of the methods used for determining the magnetic permeability of various brands of iron at different degrees of saturation. Tabular information is given as to the results found by different observers. In connection with the magnetic properties of iron, the phenomenon of magnetic hysteresis is also described and discussed. The principle of the magnetic circuit is then discussed with numerical examples, and a number of experimental data respecting the performance of electro-magnets are adduced, in particular those bearing upon the tractive power of electro-magnets. The law of traction between an electro-magnet and its armature

[1] Proceedings of the Royal Society, 1879, xxix. p. 292; *Ibid*, 1880, xxx. p. 287; Electrical Review, 1880, viii. p. 134.
[2] The Electrician, 1885–86, xiv. xv. xvi.; Proceedings of the Institute of Civil Engineers, 1885–86, lxxxiii.; Journal of the Society of Telegraphic Engineers, 1886, xv. p. 524.
[3] Philosophical Transactions, 1886, part i. p. 331; The Electrician, 1886, xviii. pp. 39, 63, 86.
[4] Journal of the Society of Telegraphic Engineers, 1886, xv. p. 555.
[5] *Ibid*, p. 530.

is then laid down, followed by the rules for predetermining the iron cores and copper coils required to give any prescribed tractive force.

Then comes the extension of the calculation of the magnetic circuit to those cases where there is an air-gap between the poles of the magnet and the armature, and where, in consequence, there is leakage of the magnetic lines from pole to pole. The rules for calculating the winding of the copper coils are stated, and the limiting relation between the magnetizing power of the coil and the heating effect of the current in it is explained. After this comes a detailed discussion of the special varieties of form that must be given to electro-magnets in order to adapt them to special services. Those which are designed for maximum traction, for quickest action, for longest range, for greatest economy when used in continuous daily service, for working in series with constant current, for use in parallel at constant pressure, and those for use with alternate currents, are separately considered.

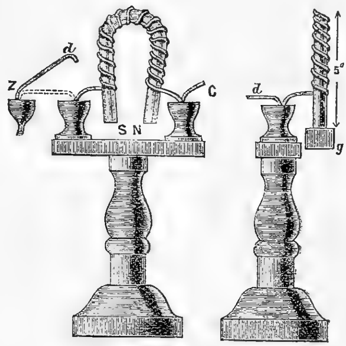
Lastly, some account is given of the various forms of electro-magnetic mechanism which have arisen in connection with the invention of the electro-magnet. The plunger and coil is specially considered as constituting a species of electro-magnet adapted for a long range of motion. Modes of mechanically securing long range for electro-magnets, and of equalizing their pull over the range of motion of the armature, are also described. The analogies between sundry electro-mechanical movements and the corresponding pieces of ordinary mechanism are traced out. The course is concluded by a consideration of the various modes of preventing or minimizing the sparks which occur in the circuits in which electro-magnets are used.

Historical Sketch.

The effect which an electric current, flowing in a wire, can exercise upon a neighboring compass-needle was discovered by Oersted in 1820.[1] This first announcement of the possession of magnetic properties by an electric current was followed speedily by the researches of Ampère,[2] Arago,[3] Davy,[4] and by the devices of several other experimenters, including De la Rive's[5] floating battery and coil, Schweigger's[5] multiplier, Cumming's[6] galvanometer, Faraday's[7] apparatus for rotation of a permanent magnet, Marsh's[8] vibrating pendulum, and Barlow's[8] rotating star-wheel. But it was not until 1825 that the electro-magnet was invented. Davy had, indeed, in 1821, surrounded with temporary coils of wire the steel needles upon which he was experimenting, and had shown that the flow of electricity around the coil could confer magnetic power upon the steel needles. But from this experiment it was a grand step forward to the discovery that a core of soft iron, surrounded by its own appropriate coil of copper, could be made to act not only as a powerful magnet, but as a magnet whose power could be turned on or off at will, could be augmented to any desired degree, and could be set into action and controlled from a practically unlimited distance.

[1] Thomson's Annals of Philosophy, October, 1820.
[2] Ann. de Chim. et de Physique, 1820, xv. pp. 59, 170.
[3] *Ibid*, p. 93.
[4] Philosophical Transactions, 1821.
[5] Bibliothèque Universelle, March, 1821.
[6] Cambridge Philosophical Transactions, 1821.
[7] Quarterly Journal of Science, September, 1821.
[8] Barlow's Magnetic Attractions, 1823 (2d ed.).

The electro-magnet, in the form which can first claim recognition for these qualities, was devised by William Sturgeon,[1] and is described by him in the paper which he contributed to the "Proceedings of the Society of Arts" in 1825, accompanying a set of improved apparatus for electro-magnetic experiments.[2] The Society of Arts rewarded Sturgeon's labors by awarding him the silver medal of the society and a premium of thirty guineas. Among this set of apparatus are two electro-magnets,—one of horseshoe shape (Figs. 1 and 2), and one a straight bar (Fig. 3). It will be seen that the former figures represent an electro-magnet consisting of a bent iron rod about one foot long, and half an inch in diameter, varnished over, and then coiled with a single left-handed spiral of stout uncovered copper wire of 18 turns. This coil was found appropriate to the particular battery which Sturgeon preferred, namely, a single cell containing a spirally enrolled pair of zinc and copper plates of large area (about 130 square inches) immersed in acid; which cell, having small internal resistance, would yield a large quantity of current when connected to a circuit of



FIGS. 1 AND 2.—STURGEON'S FIRST ELECTRO-MAGNET.

small resistance. The ends of the copper wire were brought out sideways, and bent down so as to dip into two deep connecting cups, marked Z and C, fixed upon a wooden stand. These cups, which were of wood, served as supports to hold up the electro-magnet, and, having mercury in them, served also to make good electrical connection. In Fig. 2 the mag-

[1] William Sturgeon, the inventor of the electro-magnet, was born at Whittington, in Lancashire, in 1783. Apprenticed as a boy to the trade of a shoemaker, at the age of nineteen he joined the Westmoreland Militia, and two years later enlisted into the Royal Artillery, thus gaining the chance of learning something of science, and having leisure in which to pursue his absorbing passion for chemical and physical experiments. He was forty-two years of age when he made his great, though at the time unrecognized, invention. At the date of his researches in electro-magnetism he was resident at 8 Artillery Place, Woolwich, at which place he was the associate of Marsh, and was intimate with Barlow, Christie, and Gregory, who interested themselves in his work. In 1835 he presented a paper to the Royal Society containing descriptions, *inter alia*, of a magneto-electric machine with longitudinally wound armature, and with a commutator consisting of half-disks of metal. For some reason this paper was not admitted to the Philosophical Transactions. He afterwards printed it in full, without alteration, in his volume of Scientific Researches, published by subscription in 1850. From 1836 to 1843 he conducted the Annals of Electricity. He had now removed to Manchester, where he lectured on electricity at the Royal Victoria Gallery. He died at Prestwich, near Manchester, in 1850. There is a tablet to his memory in the church at Kirkby Lonsdale, from which town the village of Whittington is distant about two miles. A portrait of Sturgeon in oils, said to be an excellent likeness, is believed still to be in existence; but all inquiries as to its whereabouts have proved unavailing. At the present moment, so far as I am aware, the scientific world is absolutely without a portrait of the inventor of the electro-magnet.

[2] Transactions of the Society of Arts, 1825, xliii. p. 38.

net is seen sideways, supporting a bar of iron, *y*. The circuit was completed to the battery through a connecting wire, *d*, which could be lifted out of the cup *Z*, so breaking circuit when desired, and allowing the weight to drop. Sturgeon added in his explanatory remarks that the poles, *N* and *S*, of the magnet will be reversed if you wrap the copper wire about the rod as a right-handed screw instead of a left-handed one, or, more simply, by reversing the connec-

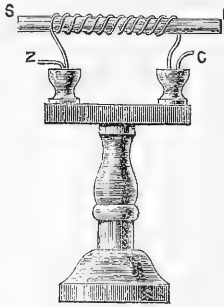


FIG. 3.—STURGEON'S STRAIGHT-BAR ELECTRO-MAGNET.

tions with the battery, by causing the wire that dips into the *Z* cup to dip into the *C* cup, and *vice versa*. This electro-magnet was capable of supporting nine pounds when thus excited.

Fig. 3 shows another arrangement to fit on the same stand. This arrangement communicates magnetism to hardened steel bars as soon as they are put in, and renders soft iron within it magnetic during the time of action. It only differs

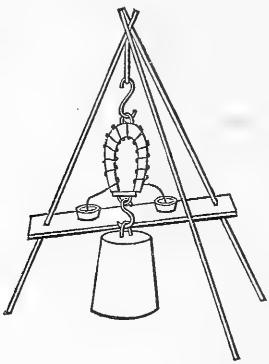


FIG. 4.—STURGEON'S LECTURE-TABLE ELECTRO-MAGNET.

from Figs. 1 and 2 in being straight, and thereby allows the steel or iron bars to slide in and out.

For this piece of apparatus and other adjuncts accompanying it, all of which are described in the society's "Transactions" for 1825, Sturgeon, as already stated, was awarded the society's silver medal and a premium of thirty guineas. The apparatus was deposited in the museum of the society, which therefore might be supposed to be the proud possessor of the first electro-magnet ever constructed. Alas for the vanity of human affairs! the society's museum of apparatus has long been dispersed, this priceless relic having been either made over to the now defunct Patent Office Museum, or otherwise lost sight of.

Sturgeon's first electro-magnet, the core of which weighed about 7 ounces, was able to sustain a load of 9 pounds, or about twenty times its own weight. At the time it was considered a truly remarkable performance. Its single layer of stout copper wire was well adapted to the battery employed, a single cell of Sturgeon's own particular construction having a surface of 130 square inches, and therefore of small internal resistance. Subsequently, in the hands of Joule, the same electro-magnet sustained a load of 50 pounds, or about a hundred and fourteen times its own weight. Writing in 1832 about his apparatus of 1825, Sturgeon used the following magniloquent language:—

"When first I showed that the magnetic energies of a galvanic conducting wire are more conspicuously exhibited by exercising them on soft iron than on hard steel, my experiments were limited to small masses, generally to a few inches of rod-iron about half an inch in diameter. Some of those pieces were employed while straight, and others were bent into the form of a horseshoe magnet, each piece being encompassed by a spiral conductor of copper wire. The magnetic energies developed by these simple arrangements are of a very distinguished and exalted character, as is conspicuously manifested by the suspension of a considerable weight at the poles during the period of excitation by the electric influence.

"An unparalleled transiliency of magnetic action is also displayed in soft iron by an instantaneous transition from a state of total inactivity to that of vigorous polarity, and also by a simultaneous reciprocity of polarity in the extremities of the bar,—versatilities in this branch of physics for the display of which soft iron is pre-eminently qualified, and which, by the agency of electricity, become demonstrable with the celerity of thought, and illustrated by experiments the most splendid in magnetics. It is, moreover, abundantly manifested by ample experiments that galvanic electricity exercises a superlative degree of excitation on the latent magnetism of soft iron, and calls for its recondite powers with astonishing promptitude, to an intensity of action far surpassing any thing which can be accomplished by any known application of the most vigorous permanent magnet, or by any other mode of experimenting hitherto discovered. It has been observed, however, by experimenting on different pieces selected from various sources, that, notwithstanding the greatest care be observed in preparing them of a uniform figure and dimensions, there appears a considerable difference in the susceptibility which they individually possess of developing the magnet powers, much of which depends upon the manner of treatment at the forge, as well as upon the natural character of the iron itself.[1]

"The superlative intensity of electro-magnets, and the facility and promptitude with which their energies can be

[1] "I have made a number of experiments on small pieces, from the results of which it appears that much hammering is highly detrimental to the development of magnetism in soft iron, whether the exciting cause be galvanic or any other; and although good annealing is always essential, and facilitates to a considerable extent the display of polarity, that process is very far from restoring to the iron that degree of susceptibility which it frequently loses by the operation of the hammer. Cylindric rod-iron of small dimensions may very easily be bent into the required form without any hammering whatever; and I have found that small electro-magnets made in this way display the magnetic powers in a very exalted degree."

brought into play, are qualifications admirably adapted for their introduction into a variety of arrangements in which powerful magnets so essentially operate, and perform a distinguished part in the production of electro-magnetic rotations; whilst the versatilities of polarity of which they are susceptible are eminently calculated to give a pleasing diversity in the exhibition of that highly interesting class of phenomena, and lead to the production of others inimitable by any other means."[1]

Sturgeon's further work during the next three years is best described in his own words:—

"It does not appear that any very extensive experiments were attempted to improve the lifting-power of electro-magnets from the time that my experiments were published in the 'Transactions of the Society of Arts, etc.,' for 1825, till the latter part of 1828. Mr. Watkins, philosophical-instrument maker, Charing Cross, had, however, made them of much larger size than any which I had employed, but I am not aware to what extent he pursued the experiment.

"In the year 1828, Professor Moll of Utrecht, being on a visit to London, purchased of Mr. Watkins an electro-magnet weighing about 5 pounds,—at that time, I believe, the largest which had been made. It was of round iron, about one inch in diameter, and furnished with a single copper wire twisted round it eighty-three times. When this magnet was excited by a large galvanic surface, it supported about 75 pounds. Professor Moll afterwards prepared another electro-magnet, which, when bent, was 12½ inches high, 2½ inches in diameter, and weighed about 26 pounds, prepared like the former with a single spiral conducting wire. With an acting galvanic surface of 11 square feet, this magnet would support 154 pounds, but would not lift an anvil which weighed 200 pounds.

"The largest electro-magnet which I have yet [1832] exhibited in my lectures weighs about 16 pounds. It is formed of a small bar of soft iron, 1½ inches across each side. The cross-piece, which joins the poles, is from the same rod of iron, and about 3¾ inches long. Twenty separate strands of copper wire, each strand about 50 feet in length, are coiled round the iron, one above another, from pole to pole, and separated from each other by intervening cases of silk. The first coil is only the thickness of one ply of silk from the iron; the twentieth, or outermost, about half an inch from it. By this mean the wires are completely insulated from each other without the trouble of covering them with thread or varnish. The ends of wire project about 2 feet for the convenience of connection. With one of my small cylindrical batteries, exposing about 150 square inches of total surface, this electro magnet supports 400 pounds. I have tried it with a larger battery, but its energies do not seem to be so materially exalted as might have been expected by increasing the extent of galvanic surface. Much depends upon a proper acid solution. Good nitric or nitrous acid, with about six or eight times its quantity of water, answers very well. With a new battery of the above dimensions and a strong solution of salt and water, at a temperature of 190° F., the electro magnet supported between 70 and 80 pounds when the first seventeen coils only were in the circuit. With the three exterior coils alone in the circuit, it would just support the lifter, or cross-piece. When the temperature of the solution was between 40° and 50°, the magnetic force excited was comparatively very feeble. With the innermost coil alone and a strong acid solution, this electro-magnet supports about 100 pounds; with the four outermost wires, about 250 pounds. It improves in power with every additional coil until about the twelfth, but not perceptibly any further: therefore the remaining eight coils appear to be useless, although the last three, independently of the innermost seventeen, and at the distance of half an inch from the iron, produce in it a lifting-power of 75 pounds.

"Mr. Marsh has fitted up a bar of iron much larger than mine, with a similar distribution of the conducting wires to that devised and so successfully employed by Professor Henry. Mr. Marsh's electro-magnet will support about 560 pounds when excited by a galvanic battery similar to mine. These two, I believe, are the most powerful electro-magnets yet produced in this country.

"A small electro-magnet, which I also employ on the lecture-table, and the manner of its suspension, are represented by Fig. 4. The magnet is of cylindric rod-iron, and weighs 4 ounces. Its poles are about a quarter of an inch asunder. It is furnished with six coils of wire in the same manner as the large electro-magnet before described, and will support upwards of 50 pounds.

"I find a triangular gin very convenient for the suspension of the magnet in these experiments. A stage of thin board, supporting two wooden dishes, is fastened at a proper height to two of the legs of the gin. Mercury is placed in these vessels, and the dependent amalgamated extremities of the conducting wires dip into it,—one into each portion.

"The vessels are sufficiently wide to admit of considerable motion of the wires in the mercury without interrupting the contact, which is sometimes occasioned by the swinging of the magnet and attached weight. The circuit is completed by other wires, which connect the battery with these two portions of mercury. When the weight is supported as in the figure, if an interruption be made by removing either of the connecting wires, the weight instantaneously drops on the table. The large magnet I suspend in the same way on a larger gin. The weights which it supports are placed one after another on a square board, suspended by means of a cord at each corner from a hook in the cross-piece, which joins the poles of the magnet.

"With a new battery, and a solution of salt and water, at a temperature of 190° F., the small electro-magnet (Fig. 3) supports 16 pounds."

In 1840, after Sturgeon had removed to Manchester, where he assumed the management of the "Victoria Gallery of Practical Science," he continued his work, and in the seventh memoir in his series of researches he wrote as follows:—

"The electro-magnet belonging to this institution is made of a cylindrical bar of soft iron, bent into the form of a horseshoe magnet, having the two branches parallel to each other, and at the distance of 4½ inches. The diameter of the iron is 2¾ inches: it is 18 inches long when bent. It is surrounded by fourteen coils of copper wire,—seven on each branch. The wire which constitutes the coils is one-twelfth of an inch in diameter, and in each coil there are about seventy feet of wire. They are united in the usual way with branch wires, for the purpose of conducting the currents from the

[1] Sturgeon's Scientific Researches, p. 113.

battery. The magnet was made by Mr. Nesbit. . . . The greatest weight sustained by the magnet in these experiments is $12\frac{3}{4}$ hundredweight, or 1,386 pounds, which was accomplished by sixteen pairs of plates, in four groups of four pairs in series each. The lifting-power by nineteen pairs in series was considerably less than by ten pairs in series, and but very little greater than that given by one cell or one pair only. This is somewhat remarkable, and shows how easily we may be led to waste the magnetic powers of batteries by an injudicious arrangement of its elements."[1]

At the date of Sturgeon's work the laws governing the flow of electric currents in wires were still obscure. Ohm's epoch-making enunciation of the law of the electric circuit appeared in "Poggendorf's Annalen" in the very year of Sturgeon's discovery, 1825; though his complete book appeared only in 1827, and his work, translated by Dr. Francis into English, only appeared (in Taylor's "Scientific Memoirs," vol. ii.) in 1841. Without the guidance of Ohm's law, it was not strange that even the most able experimenters should not understand the relations between battery and circuit which would give them the best effects. These had to be found by the painful method of trial and failure. Preeminent among those who tried was Professor Joseph Henry, then of the Albany Institute in New York, later of Princeton, N.J., who succeeded in effecting an important improvement. In 1828, led on by a study of the "multiplier" (or galvanometer), he proposed to apply to electro-magnetic apparatus the device of winding them with a spiral coil of wire "closely turned on itself," the wire being of copper from one-fortieth to one-twenty-fifth of an inch in diameter, covered with silk. In 1831 he thus describes[2] the results of his experiments:—

"A round piece of iron about a quarter of an inch in diameter was bent into the usual form of a horseshoe; and instead of loosely coiling around it a few feet of wire, as is usually described, it was tightly wound with 35 feet of wire covered with silk, so as to form about 400 turns. A pair of small galvanic plates, which could be dipped into a tumbler of diluted acid, was soldered to the ends of the wire, and the whole mounted on a stand. With these small plates, the horseshoe became much more powerfully magnetic than another of the same size and wound in the same manner, by the application of a battery composed of 28 plates of copper and zinc, each 8 inches square. Another convenient form of this apparatus was contrived by winding a straight bar of iron, 9 inches long, with 35 feet of wire, and supporting it horizontally on a small cup of copper containing a cylinder of zinc. When this cup, which served the double purpose of a stand and the galvanic element, was filled with dilute acid, the bar became a portable electro-magnet. These articles were exhibited to the institute in March, 1829. The idea afterwards occurred to me that a sufficient quantity of galvanism was furnished by the two small plates to develop, by means of the coil, a much greater magnetic power in a larger piece of iron. To test this, a cylindrical bar of iron, half an inch in diameter, and about 10 inches long, was bent into the shape of a horseshoe, and wound with 30 feet of wire. With a pair of plates containing only $2\frac{1}{2}$ square inches of zinc, it lifted 15 pounds avoirdupois. At the same time a very material improvement in the formation of the coil suggested itself to me on reading a more detailed account of Professor Schweigger's galvanometer, which was also tested with complete success upon the same horseshoe. It consisted in using several strands of wire, each covered with silk, instead of one. Agreeably to this construction, a second wire, of the same length as the first, was wound over it, and the ends soldered to the zinc and copper in such a manner that the galvanic current might circulate in the same direction in both; or, in other words, that the two wires might act as one. The effect by this addition was doubled, as the horseshoe, with the same plates before used, now supported 28 pounds.

"With a pair of plates 4 inches by 6 inches, it lifted 39 pounds, or more than fifty times its own weight.

"These experiments conclusively proved that a great development of magnetism could be effected by a very small galvanic element, and also that the power of the coil was materially increased by multiplying the number of wires without increasing the number of each."[1]

[1] Sturgeon's Scientific Researches, p. 188.

[2] Silliman's American Journal of Science, January, 1831, xix. p. 400.

[1] Scientific Writings of Joseph Henry, p. 39.

NOTES AND NEWS.

THE well known writer on vegetable paleontology, Professor E. Weiss of Berlin, died on July 5 last.

—The annual meeting of the American Folk-Lore Society will be held Nov. 28 and 29, 1890, at Columbia College, New York. A preliminary meeting for the purpose of organizing a local committee of arrangements was held at Room 15, Hamilton Hall, Columbia College, 49th Street and Madison Avenue, on Wednesday, Oct. 8, at 4 P.M.

—We learn from the *Medical and Surgical Reporter* of Oct. 4 that there were registered in the second trimester 908 foreigners who were studying medicine in France, of whom 822 were in Paris. Of the latter there were, from Russia, 261; the United States, 159; Roumania, 85; Turkey, 71; England, 51; Spain, 34; Greece, 34; Switzerland, 25; Servia, 20; Portugal, 18; Egypt, 13; Italy, 12; Bulgaria, 8; Austria, 7; Belgium, 7; and Holland, 60.

—By the death of Professor Carnelley the science of chemistry in England has suffered an irreparable loss. It appears, as we learn from *Nature*, that some little time ago Dr. Carnelley had been suffering from an attack of influenza, and it was while returning to Aberdeen after a journey to the south, made with the object of recruiting his health, that he was seized with sudden and severe illness, which was due, as his medical attendants discovered, to the formation of an internal abscess. Surgical aid proved unavailing, the patient's strength gradually gave way, and Dr. Carnelley passed away at mid-day of Aug. 27, at the comparatively early age of thirty-eight.

—The report of Dr. Eitel, inspector of schools in Hong Kong, for the past year, contains some interesting details. According to *Nature*, the total number of educational institutions of all descriptions, known to have been at work in the colony of Hong Kong during the year 1889, amounts to 211 schools, with a grand total of 9,681 scholars under instruction. More than three fourths of the whole number of scholars, viz., 7,659, attended schools (106 in number) subject to government supervision, and either established or aided by the government. The remainder, with 2,022 scholars, are private institutions, entirely independent of government supervision, and receiving no aid from public funds. The total number of schools subject to direct supervision and annual examination by the inspector of schools amounted, in 1389, to 104, as compared with 50 in 1879, and 19 in 1869. The total number of scholars enrolled in this same class of schools during 1889 amounted to 7,107, as compared with 3,460 in 1879, and 942 in 1869: in other words, there has been an increase of 31 schools and 2,518 scholars during the ten years from 1869 to 1879, and an in-

crease of 54 schools and 3,647 scholars during the ten years from 1879 to 1889. It would seem, therefore, that the decennial increase of schools and scholars during the last twenty years has shown a tendency to keep up with the progressive increase of population. Comparing the statistics of individual years, the number of schools under supervision and examination by the inspector of schools rose from 94 in 1887, and 97 in 1888, to 104 in 1889, while the number of scholars under instruction in these same schools rose from 5,974 in 1887, and 6,258 in 1888, to 7,107 in 1889. There is, therefore, a steady annual increase during the last three years, progressing from an increase of 284 scholars in 1888 to an increase of 849 in 1889. The expenses incurred by the government during the year 1889, on account of education in general, amounted, exclusive of the cost of new school-buildings, to a total of $53,901.

—Mr. E. Nevill, the government chemist at Natal, in his last report to the colonial secretary, notes that valuable deposits of argentiferous galeno of copper and of bismuth exist in the colony, and of such rich nature that they could be profitably exported in bulk. In both Alexandra and Umvoti Counties, as stated in *Nature* of Sept. 25, deposits of silver-bearing lead ore have been found containing from ten to fifteen pounds' worth of silver per ton of lead ore. Saltpetre has been found so rich as to be worth more than three times as much as the best Peruvian deposits. Plumbago, asbestos, and the mineral phosphates appear to be of inferior quality. Several calcareous formations have been examined, which are likely, under proper treatment, to yield good hydraulic cement.

—Some chemical re-actions can be started or accelerated by sunlight, and an increased effect is to be expected where the rays are concentrated by a lens or concave mirror. Herr Brühl has described experiments made in this way, in production of zinc ethyl from zinc and ethyl iodide,—a re action difficult to start. As given in *Nature*, the retort, containing zinc filings and several hundred grams of ethyl iodide, was placed at the focus of a concave mirror, about a foot in diameter, receiving the sun's rays. The re-action soon began, and grew so vigorous that cooling was necessary. In a quarter of an hour all the ethyl iodide was conconsumed, and, through the subsequent distillation in an oil-bath, a good yield of zinc ethyl was had. This radiation process, it is suggested, might be variously useful in actions on halogen-compounds, which tend to be disaggregated by sunlight A lens, owing to the athermanous property of glass, would be less powerful.

—Lord Rayleigh has recently had under observation, says *Engineering* of Sept. 26, some cases of defective color-vision which prove, what seems only natural, that we cannot simply distinguish trichromic and dichromic color-vision, as has sometimes been done. Normal color-vision is trichromic; color-blind people have dichromic vision. If we have black, white, blue, red, green, we can match two against three. For dichromic vision we want only four colors; for instance, those mentioned without white. For ordinary purposes the wool test will suffice: if not, we recur to spinning disks,—two concentric disks, the one over the other, the inner one consisting of sectors of different colors, the outer one showing ring portions. The disks are made of colored cardboard, and have a radial slit, so that we can make up any combination we like; e.g., 10 parts of black + 45 white + 35 green, 100 making the total circumference. Sometimes patients prove obstinate, and will not say when they consider the inner and outer disk matches. Such are examined by means of an older apparatus of Lord Rayleigh's, a color-box with a revolving Nicol. Here they often commit themselves, and discover differences of brightness only, where there are evident differences of color. As an example of a peculiar match, Lord Rayleigh gave the following: 64 green + 36 blue = 61 black + 39 white, that is, a green-blue against a gray; another, 82 red + 18 blue (crimson) = 22 green + 78 blue. But such people are not always consistent in their way: they will make certain matches, but refuse to acknowledge others which appear suited for them. One case, for instance, first thought to be dichromic, finally proved not to be so; the sensibility for red not being altogether absent, but only impaired. Such cases have been little studied as yet. Lord Rayleigh further referred at the meeting of the British Association, at which his paper was delivered, to Maxwell's color-triangle, and the position of the black and the dark spot.

—The last two numbers of *Cosmos* contain some very interesting information on various topics. Some new discoveries have been made at Pompeii, near the Stabiana Gate, and a description is given of them. *Nature* states that three bodies were found, two being those of men, and the third that of a woman. Not far from the resting-place of these bodies was found the trunk of a tree, 3 metres in height, and measuring 40 centimetres in diameter. This tree, together with its fruits that were found with it, have been examined by the professor of botany, M. Pasquale, who finds in it a variety of *Laurus nobilis*. By means of the fruits, since they come to maturity in the autumn, he concludes that the eruption did not take place in August, but in November.

—It was observed a short time ago by Dr. Kremser, says *Nature* of Sept. 25, that the curve of mortality in North Germany lagged about two months behind that of the variability of temperature. An inquiry into this matter in the case of Budapesth has been lately made by Dr. Hegyfoky, taking the nine years 1873–81. Comparing the months, he failed to make out a certain connection; but taking into account other meteorological elements besides temperature, and reckoning by seasons, he found the variability of weather in the different seasons to give the following order from maximum to minimum: winter, spring, autumn, summer. As regards mortality, the order was spring, summer, winter, autumn. Thus it appears there is a displacement of three months. If a connection of the kind referred to really exists between weather and mortality, the effect (mortality) must appear somewhat later than the cause (variation of weather).

—We learn from *Engineering* of Sept. 26 that the Forth Bridge has been for some time entirely completed, the works have been dismantled, and the engineers' staff and the workmen have had to seek new fields of operation, some of the engineers having gone to Mexico, America, Greece, and India. The finishing touch, it is interesting to note, is the only thing in the way of ornament on the bridge, all else being indispensable parts of the structure. This embellishment consists of two brass plates placed on the south cantilever pier, in commemoration of the opening of the bridge by the Prince of Wales on March 4, 1890. The names of the directors, engineers, and contractors are also given. Sir John Fowler has had fitted at the end of the south main span, at which point the contraction and expansion joint is placed, an indicator to record the number of trains passing and the daily contraction or expansion of the bridge. The apparatus consists of a brass rod, with a pencil, attached to the end of the girder, and a clock with another brass rod fixed in its axle. Round the rod in the axle of the clock is wound a strip of paper about four inches wide, with a weight attached to the end. The point of the pencil rests on this paper, which is, of course, constantly on the move as the clock winds down. The result is, that as the cantilever contracts, the pencil attached to it is pulled away; when it expands, the pencil is pushed forward; and a curve of contraction and expansion is thus produced by the movement of paper and pencil combined. The same principle is applied to register the behavior of the bridge while a train is passing. When the train enters on the one end of the cantilever, it pulls the far-off end down; and when it does so, it also pulls the pencil, and thus a mark at right angles to the curve of contraction and expansion is made. When it passes to the other half of the cantilever, it pushes it forward, and again a mark at right angles to the curve is made on the other side. Each mark indicates a train, and thus the simple apparatus serves three purposes. The management are troubled a good deal with requests for passes to inspect the bridge; but as walking over the bridge, owing to the narrowness of the sidewalk, is attended with considerable danger, very few are granted. The speed of the trains in crossing the bridge is not now limited, except in the case of goods trains, and with them it must not exceed twenty-five miles an hour. As there are only about two feet six inches between the pedestrian on the bridge and the flying train, it is seen that the precaution is wise. The average traffic on the bridge amounts to about one hundred and forty trains daily.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

AN IMPORTANT MEETING OF MINING AND METALLURGICAL ENGINEERS.

A joint meeting of the American Institute of Mining Engineers, the Iron and Steel Institute of Great Britain, and the Verein Deutscher Eisenhuettenleute of Germany, was held in this city last week. The meeting of the American Institute of Mining Engineers occupied the first two days, the sessions being held in Chickering Hall. At the first session, on Monday afternoon, addresses of welcome were delivered by J. F. Lewis and Hon. Abram S. Hewitt. Then, after some routine business, the reading of papers began, the first being on "Explosions from Unknown Causes," by J. C. Bayles. Five other papers, by John C. Fowler, F. H. McDowell, Clemens Jones, C. M. Ball, and Oberlin Smith, were read by title.

At the Monday evening session papers were read by W. B. Potter and W. F. Durfee.

The first paper of the Tuesday morning session, by H. H. Campbell, was read by title and not discussed. In the next paper, by H. C. Spaulding, which treated of electric power-transmission in mining operations, and in the discussion of it, the advantages of the alternating current for the distribution of power over long distances were clearly set forth. The other papers at this session were read only by title.

On Tuesday afternoon only two papers were read and discussed; namely, "Recent Improvements in German Steel-Works and Rolling-Mills," by R. M. Daelen, and "Machinery for Charging and Heating Melting-Furnaces," by S. T. Wellman. Several other papers were read by title.

At the Tuesday evening session Alphonse Fteley read a paper on "The Water-Supply of New York City." The concluding papers of the session were by James Douglas, jun., and Eckley B. Coxe.

On Wednesday morning the Iron and Steel Institute began its meeting, President Sir James Kitson in the chair. Andrew Carnegie, chairman of the reception committee, delivered the address of welcome, which was responded to by the president, who then read his formal presidential address. The usual routine business of the institute was then disposed of. Technical papers were read by James Gayley and E. S. Cook. In the afternoon all who desired went on an excursion up the Hudson.

On Thursday the Bessemer gold medal and diploma were formally presented to Hon. Abram S. Hewitt. In the afternoon James Dredge, editor of *Engineering*, delivered an address on the late Alexander Lyman Holley, after which the audience went in a body to Washington Square, where a statue of Holley was unveiled. The evening was devoted to banquets and receptions.

On Friday visits were made to points of interest in and about the city, and on Saturday the visitors departed for Philadelphia.

WHEAT SMUT.

Bulletin No. 12 of the Experiment Station of the Kansas State Agricultural College, Manhattan, Kan., is on some "Preliminary Experiments with Fungicides for Stinking-Smut of Wheat." In very many localities, in nearly every wheat-growing country, the crop is more or less injured, and sometimes seriously damaged, by a disease called "stinking-smut," "bunt," or simply "smut." This disease is not detected until the plants have headed out, and even then it is often overlooked. Before the grain ripens, a careful examination reveals the fact that certain heads have a dark, bluish-green color, while healthy plants present a lighter, yellowish-green color. During and after ripening of the grain, the smutted heads have a paler appearance than healthy ones. At no time do the smutted heads present the yellowish shade so characteristic of ripening wheat. When the smutted heads are examined, it is found that the grains have become dark and more or less swollen. They are at first of a greenish color, but become brownish or grayish when fully ripened. Because of their being usually swollen, the smutted grains push the chaff apart more than the sound kernels do, giving the head a slightly inflated and somewhat abnormal appearance. If one of the swollen smutted grains be crushed, it is found to be filled with a rather dull-brownish powder, which has a very disagreeable and penetrating odor. Often the disease is not discovered till the grain is threshed, when it is recognized by the odor arising from the smutted grains crushed by the machine. The smut may also be recognized during the milling, both from the odor arising during the grinding and by the dark streaks found in the flour. The dissemination of the disease is brought about by the use of smutted seed. The brown powder (smut) lodged in the threshing-machine may infect the seed, or the smut remaining in the field may, perhaps, through the soil, infect the succeeding crop. A summary of the results of the experiments at the Kansas Station, which were carried out by the botanists W. A. Kellerman and W. T. Swingle, shows that the stinking-smut of wheat is a destructive disease, caused by two closely allied, parasitic fungi called *Tilletia fœtens* and *Tilletia Tritici;* that these two species of smut differ only in a few microscopic characters, and both produce the same disease; that the disease is spread by spores of these fungi adhering to the sound grains before they are planted, or perhaps rarely by spores present in the soil; that the damage from this disease is often very considerable, sometimes amounting to from one-half to three-quarters of the whole crop; that in ordinary cases the disease can be entirely prevented by soaking the seed fifteen minutes in water heated to 132° F.; that the other fungicides used, when decreasing the amount of smut, at the same time also interfered with the germination, and reduced the vigor of the plants; and that seed from clean fields (if the adjoining fields were not smutty) will produce a crop of wheat free from smut.

HEALTH MATTERS.

The Diaphanous Test of Death.

DR. BENJAMIN WARD RICHARDSON, in the last *Asclepiad*, speaks of a paragraph making the round of the scientific and general press which must be accepted *cum grano*. In this paragraph, according to the *Boston Medical and Surgical Journal*, it is stated that the French Academy of Sciences ten or fifteen years ago offered a prize of $8,000 for the discovery of some means by which even the inexperienced might at once determine whether in a given case death had or had not ensued. A physician obtained the prize. He had discovered the following well-known phenomenon. If the hand of the suspected dead person be held towards a candle or other artificial light with the fingers extended and one touching the other, and one looks through the spaces between the fingers towards the light, there appears a scarlet red color where the fingers touch each other, due to the blood still circulating, and showing itself through the tissues, if life have not yet ceased. When life is entirely extinct, the phenomenon of scarlet space between the fingers at once ceases. The most thorough trials, it was said, had established the truth of this observation.

Dr. Richardson says that in his essay on absolute proofs of death he has described this test with the others, and has attached to it its true value. The statement that the test is sufficient of itself is, however, too solemn to be allowed to go without correction; and he therefore affirms, with all possible earnestness, that the test, trusted to alone, is capable of producing the most serious error. In the case of a person in a state of syncope, where the test was most carefully applied, there was not the faintest trace of red coloration between the fingers; yet recovery from the syncope was quite satisfactory without any artificial aid. The test is one which admits of being readily tried, and, *prima facie*, it is a good test to bring into operation. But as an absolute proof of death Dr. Richardson would put before it, (1) the pulsation of the heart, (2) the respiratory murmur, (3) pressure on veins, (4) the electric test for muscular irritability, (5) the ammonia hypodermic test, (6) coagulation of blood in the veins, (7) rigor mortis, and (8) decomposition.

Impurities under Finger-Nails.

The progress of bacteriology has shown that aseptic surgery means scientific cleanliness. The same lines of investigation show how very dirty people can be. Seventy-eight examinations of the impurities under finger-nails were made in the bacteriological laboratories of Vienna, and the cultivations thus produced showed thirty-six kinds of micrococci, eighteen bacilli, three sarcinæ, and various varieties. The spores of common mould were very frequently present. The removal of all such impurities is an absolute duty in all who come near a wound. It is not enough to apply some antiseptic material to the surface of dirt: the impurity must be removed first, the hand antisepticized after. Some physicians, when intending to drain dropsical legs by acupuncture or other methods, are very careful to use antiseptic dressings, and in such cases have the feet and toe-nails purified and rendered aseptic as far as possible. It is sometimes said that the scratch of a nail is poisonous. There is no reason to suspect the nail-tissue: it is more likely the germs laid in a wound from a bacterial nest under the nail. Children are very apt to neglect to purify their nails when washing hands; and this matter is not always sufficiently attended to among surgical patients. Personal cleanliness is a part of civic duty, and, as Dr. Abbott well expressed the matter in his address to teachers, should be taught to school-children, and insisted on in practice. The facts we have recorded might well form the text for a school homily, especially when any epidemic was in the neighborhood.

Some Cases of Prolonged Want of Food.

A correspondent of *The Lancet* writes as follows on this subject: "The name of Gen. Colletta, author of the 'History of the Kingdom of Naples from 1734 to 1825,' is one of the most respected in the annals of modern Italy, and his reputation for discernment and veracity may fairly be placed on a level with that of the Duke of Wellington in our own country. His description of the terrible earthquake which in 1783 devastated Calabria, and was severely felt throughout the Kingdom of the Two Sicilies, is of unquestioned authority, and from it the following incidents are extracted. They refer only to persons and animals imprisoned beneath the ruins caused by the earthquake. It is only necessary to add that the facts were ascertained by Gen. Colletta's personal investigations at the scene of the catastrophe. 1. A female child, eleven years of age, was extricated on the sixth day and lived; and another girl, sixteen years of age, Eloisa Basili, remained under ground for eleven days, holding in her arms an infant which had died on the fourth day, so that it was decomposed and putrefied at the time of her rescue. She was unable to free herself from the shocking burden in her arms, so closely were they hemmed in by the fallen wreckage. 2. More wonderful still, as regards duration of life, were certain cases that occurred among animals. Two she-mules existed under a heap of ruins, the one twenty-two days, the other twenty-three; a fowl lived for twenty-two days; and a pair of hogs, which were completely entombed, remained alive thirty-two days. The human beings who had undergone these unwonted privations, when interrogated as to their sensations, replied, 'I can recollect only up to a certain point, and then I fell asleep.' When it is remembered that all the creatures thus circumstanced were deprived entirely of water or other liquids, it is hardly to be wondered at, that, though there was no desire for solid food, they displayed on their liberation an insatiable thirst, and, the author adds, partial blindness,—*sete inestinguibile e quasi cecità.*"

Long-Immersed Human Subjecst.

A very interesting report has just been issued by Dr. König of Hermannstadt, on the state in which the human subject, after forty years' immersion in water, may be found by the physiologist. In the revolutionary upheaval of 1849, a company of Honvéds, as the Hungarian militia are called, having fallen in the vicissitudes of war, were consigned to the waters of the Echoschacht, a pool of considerable depth not far from Hermannstadt. Their bodies, as we learn from the *Lancet* of Aug. 9, 1890, have recently been brought up to the light of day, and subjected to a careful and minute investigation from the physiologist's point of view. Dr. König found them in perfect preservation, without a single trace of any decomposing process. Externally they had the appearance of having been kept in spirit. The epidermis was of a whitish-gray color; the muscles, rose-red, feeling to the touch like freshly slaughtered butcher's meat. The lungs, heart, liver, spleen, kidneys, bladder, stomach, and alimentary canal were of the consistence of those in a newly deceased corpse; while the brain was hard and of a dirty-gray color, as if preserved in spirit. Structurally the organs retained their outline perfectly, and were so easily recognizable in tissue as well as configuration, that, according to Dr. König, they might have been exhibited for "demonstration" in an anatomical lecture-room. After forty-one years under water, these are indeed remarkable phenomena. The large intestine contained fæces of a yellowish-brown color, quite unaltered and inodorous; while the bladder was partially filled with straw-colored urine. But perhaps the most significant feature disclosed by these corpses is the following: in their interior a large amount of chloride of sodium, crystallized in cubes, had been deposited and fixed on the several tissues and organs, and this salt had not penetrated mechanically into the dead bodies from without. In the completely closed and perfectly unimpaired pericardium, and also on the outer surface of the heart itself, crystals of the same kind were found. This, according to Dr. König, clearly shows, that, in the water, particles held in solution may pass through the skin and the muscles, and find their way into the most deeply seated organs. Herein, he adds, we have confirmatory proof, if such were needed, that the specific virtues of mineral baths exercise in this way their salutary effect on the internal economy of the bather. There is a notable difference, however, between the time spent in the bath by an ordinary bather at a "Curort" and the forty-one years during which the Honvéds remained under water. The phenomenal quietness of the Echoschacht may also have been a material factor in this impregnation.

of the corpses with chloride of sodium. But, with every allowance for such considerations, Dr. König has furnished a striking illustration of the permeability of the immersed human subject to salts in solution, and it is to be hoped that his painstaking researches will lead to others in the same important direction.

Medical Students Abroad.

Human beings are so much like sheep in their habit of following where their predecessors have led, says *Medical News* of Aug. 30, 1890, that it seems almost useless to attempt to divert their course from the clinics of Vienna or Berlin to those of London, Liverpool, or Edinburgh. Yet any one who has studied both on the continent of Europe and in England must have been impressed with a number of advantages possessed by English study over those offered in still more foreign lands. The advantage of the mother-tongue is inestimable. Very few Americans who do not possess German blood know enough of the German language to understand the terms used by a rapid lecturer in the Fatherland; and, if they do not, they lose that which they chiefly desire, namely, the minute points of the subject before them. The average American going to one of the continental clinics receives most of his instruction from docents, or other instructors of a comparatively low grade, simply because he is one of hundreds who not only throng around the chief, but overflow to the subordinates; while in England, notably in London, the number of eminent men is so great, and the percentage of foreign students so small, that each and every one can sit at the feet of the teacher whose writings are known everywhere in the civilized world. While the student in Berlin or Vienna becomes imbued with the views of the single individual governing a given course, in London he may go from hospital to hospital and obtain different views, and in consequence become a man of broader ideas and greater resource.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

On the Minerals contained in a Kiowa County (Kansas) Meteorite.

A REMARKABLE group of meteorites has been discovered during the past year in Kiowa County, Kan. In March last a small fragment was identified by the author as being of meteoric origin, and steps were taken by Dr. F. H. Snow of the Kansas State University, Professor F. W. Cragin of Washburn College, and others, to obtain some of these masses.

The history of this find has been described by Dr. Snow (*Science*, May 9, 1890) and by George F. Kunz (*Science*, June 13, 1890). The latter writer, to whom a large number of the specimens of this fall belong, describes some very carefully, and gives some analyses of the minerals contained. In *Science*, July 18, 1890, another specimen, more recently found at this locality, is described. This as well as others noticed belongs to the class known as "pallasites." Its weight is two hundred and eighteen pounds and a quarter.

It is an irregular triangular pyramid about twenty-two inches in height, with a maximum width of seventeen inches. As it was well buried in the mud, one side of it presents numerous cavities in which are crystals that have not been destroyed by handling or by the action of the elements. One of these cavities is four inches in diameter and two inches deep. Nearly all these cavities are filled with more or less perfect crystals of light-yellow olivine and chromite.

The general color of the meteorite is a mottled reddish black, but it is redder than other specimens of this group that we have seen.

The specific gravity of the whole mass was 4.79, showing that there is not as much iron as in some of the specimens reported. A dirty-white incrustation was noticed at several places on the surface. This proved to be calcium carbonate, and is no doubt due to a deposit from the calcareous soil in which the mass was buried. A polished section shows the usual Widmannstattian figures after treatment with nitric acid.

Some quite perfect crystals of yellow olivine were secured. There is much more of an almost black variety of this mineral. Of the latter no analysis was made, as it did not seem possible to secure a uniform sample. It is suggested by Mr. Kunz that this zone is a mixture of olivine and troilite. The yellow olivine has a fusibility of 5+, blackens before the blowpipe, is attracted by the magnet after ignition but not before, gives the usual iron reaction with the borax bead, and is soluble in nitric acid with separation of gelatinous silica. It has conchoidal fracture and vitreous lustre. The analysis is as follows: —

SiO_2	38.38
FeO	13.55
MgO	46.21
MnO	.29
Cr_2O_3	.61
S	a trace
Loss on ignition	.82
	99.86

The chromite, which is found in crystals and masses lining the cavities above mentioned, is iron-black in color, with a brilliant lustre. It is brittle, gives a brown streak, and is slightly magnetic after ignition. It gives the usual emerald-green bead with borax. It is not acted upon by acids. Some of the masses are one third of an inch in diameter. In most of these cavities there are about equal quantities of olivine and of chromite. The analysis is as follows:—

SiO_2	1.42
CaO	0.78
MgO	6.11
FeO	23.21
Al_2O_3	0.25
MnO	a trace
Cr_2O_3	67.83
Loss on ignition	.24
	99.84

The iron-nickel alloy, as shown on a polished surface, is intimately associated with the troilite. Its specific gravity is 7.70. It has the following composition:—

Iron	88.08
Nickel	11.04
Cobalt	.56
Sulphur	.10
Phosphorus	.11
Silicon (?)	.05
Copper	a trace
	99.94

A specimen of troilite from the 54.96 pound meteorite of this group was also examined in our laboratory. It could not be picked clean from iron and olivine. After excluding silica and magnesia of the olivine, the composition corresponded quite closely with the analyses of troilite as reported in Dana's "Mineralogy."

This specimen is remarkable on account of the size of the depressions on its surface, and the fact that these depressions contain such pure crystals and masses of both olivine and chromite. In the interior the olivine occurs in rounded grains, filling the cavities of the iron.

E. H. S. BAILEY.

Lawrence, Kan., Aug. 15.

The Unit Measure of Time.

ON the question of a name for the time-unit, referred to in an article by Dr. Sandford Fleming of Ottawa, in *Science* of Sept. 26, I see nothing better for what he wants named than "mean solar day." No suitable word of classical derivation occurs to me after thinking of the matter; and I find "mean solar day" as little objectionable as "tropical" or "sidereal," etc., "year." The best time-unit would probably be a pendulum-oscillation (of a given length) vibrating *in vacuo* at the pole of the earth.

C. MACDONALD.

Dalhousie College, Halifax, N.S., Oct. 1.

BOOK-REVIEWS.

Elliptic Functions. By ARTHUR L. BAKER. New York, Wiley. 8°. $1.50.

THOSE who want to take up this somewhat complicated subject, and who have been repelled by the larger works of foreign writers, will be glad to get hold of Professor Baker's work, who is, by the way, the professor of mathematics in the Stevens School of the Stevens Institute of Technology, Hoboken, N.J., and who was formerly connected with the scientific department of Lafayette College, Easton, Penn.

Professor Baker does not pretend to have contributed any thing to the methods of treatment, but he has aimed at smoothing the road to this increasingly important branch of mathematics, and of putting within reach of the English student a tolerably complete outline of the subject, clothed in simple mathematical language and methods.

The Principles of Psychology. By WILLIAM JAMES. 2 vols. (American Science Series, Advance Course.) New York, Holt. 8°.

IN the presence of two large and weighty volumes, embodying the slowly matured thoughts of an able and original thinker upon a subject teeming with new and fascinating problems, but no less so with difficulties and pitfalls, the reviewer finds his task no ordinary one. He feels that he has before him a work destined to have considerable influence upon the progress of psychological science amongst us, and especially so because it appears at a time in the growth of the science which is particularly responsive to formative influences, and because it appeals to the advanced student, who has in some part acquired the fundamental facts, and is ready to form interpretations and opinions of his own,—a work for which the teacher of psychology will find a handy place on his book-shelf, and to which all those who in the future may attempt surveys of psychological science will make repeated and pertinent reference.

The attitude of the author to his subject is precisely that of the expert in any department of exact science to his chosen specialty. It is to psychology as a science—to scientific psychology—that Professor James contributes. "I have kept close to the point of view of natural science throughout the book. Every natural science assumes certain data uncritically, and declines to challenge the elements between which its own 'laws' obtain, and from which its own deductions are carried on. . . . This book, assuming that thoughts and feelings exist and are vehicles of knowledge, thereupon contends that Psychology, when she has ascertained the empirical correlation of the various sorts of thought or feeling with definite conditions of the brain, can go no farther—can go no farther, that is, as a natural science. If she goes farther, she becomes metaphysical." While psychology thus demands recognition as a distinct one of the sciences, it is equally desirous of keeping in intimate relationship with every other department of knowledge that can contribute to its completeness, or to which it may be useful. Especially in the present stage of rapid growth is it necessary to keep eyes and ears open to suggestions from any source, and to refrain from any narrow though ever so systematic definition of the province of psychology. Professor James's expression of this need, and defence of this position, are so admirable as to demand citation.

"The boundary-line of the mental is certainly vague. It is better not to be pedantic, but to let the science be as vague as the subject and include such phenomena as these, if by so doing we can throw any light on the main business in hand. It will ere long be seen, I trust, that we can, and that we gain much more by a broad than by a narrow conception of our subject. At a certain stage in the development of every science a degree of vagueness is what best consists with fertility. On the whole, few recent formulas have done more real service of a rough sort in psychology than the Spencerian one, that the essence of mental life and of bodily life are one, namely, 'the adjustment of inner to outer relations.' Such a formula is vagueness incarnate; but because it takes into account the fact that minds inhabit environments, which act on them, and on which they in turn re-act; because, in short, it takes mind in the midst of all its concrete relations,—it is immensely more fertile than the old-fashioned 'rational psychology,' which treated the soul as a detached existent, sufficient unto itself, and assumed to consider only its nature and properties. I shall therefore feel free to make any sallies into zoölogy or into pure nerve-physiology which may seem instructive for our purposes, but otherwise shall leave those sciences to the physiologists."

While thus free to borrow from more mature sciences, psychology is not less free to develop its own methods and resources. Experimental psychology is not co extensive with scientific psychology: observation, hypothesis, comparison, and that much-abused introspection, have all equally worthy places. The mere mental fact means about as little as any other: the interpretation of it gives it life and a place in science. Such interpretation is frequently impossible except by the inner consultation of personal experience by introspection. The introspection that is dangerous, and upon which a justifiable odium has fallen, is one that soars free of experience, takes no account of the peculiarities of the mind that is "introspected," and ends by forcing the facts into accord with a fanciful theory. The introspection that Professor James so cleverly employs is one that welcomes any possible corroboration or suggestion from experiment,—one that is made necessary by the inadequacy of the facts, and has for its end the accumulation of further knowledge.

Having thus indicated the spirit and methods of the work, we may proceed to examine its scope and subject-matter. This it is difficult to describe except by enumerating the titles of chapters. It is difficult to discover the guiding principle according to which one topic is treated fully, a second sparingly, and a third entirely ignored. Indeed, one derives the impression that this guiding principle is none other than the personal interests of the author. He has gathered together the various problems of which he has at various times made special study (and in part published the results), and added thereto certain other chapters allied to these in the way of introduction or corollary. It is not, and makes no pretence of being, a systematic work. The topics most liberally treated are such as the perception of space, perception of time, perception of "things," perception of reality, the stream of thought, association, attention, imagination, self-consciousness, the emotions, the will, necessary truths; though the more concrete problems of the functions of the brain, habit, discrimination and comparison, memory, instinct, hypnotism, are by no means slighted. The order of topics is also not the usual one. First are treated the complex mental operations as presented in the adult thinker; and then, as analysis shows the possibility of viewing these as elaborate instances of simpler abstract processes, the latter are more specifically studied.

The manner of treatment is everywhere attractive, and there are few dull pages in the book. There is a wealth of illustrative material gathered from a great variety of sources, and the descriptions of mental and emotional conditions are always bright and pertinent. As one instance of many, take the following description of the state of distraction, or "brown study:" "The eyes are fixed on vacancy; the sounds of the world melt into confused unity; the attention is dispersed so that the whole body is felt, as it were, at once; and the foreground of consciousness is filled, if by any thing, by a sort of solemn sense of surrender to the empty passing of time. In the dim background of our mind we know, meanwhile, what we ought to be doing: getting up, dressing ourselves, answering the person who has spoken to us, trying to make the next step in our reasoning. But somehow we cannot *start:* the *pensée de derrière la tête* fails to pierce the shell of lethargy that wraps our state about. Every moment we expect the spell to break, for we know no reason why it should continue. But it does continue, pulse after pulse, and we float with it until —also without reason that we can discover—an energy is given, something—we know not what—enables us to gather ourselves together, we wink our eyes, we shake our heads, the background-ideas become effective, and the wheels of life go round again."

Finally, with regard to the practical value of the work. What is its place as a text-book? It certainly can hope for only a limited field. It takes for granted that knowledge which it is the purpose of most college courses in psychology to convey; and,

even when such topics are treated, the discussion is begun *in medias res*, taking up the points of chief interest and referring to other works for the rest. There are few students indeed who can be counted upon to have this knowledge; and there is great danger that the student will think he has practically acquired this knowledge when he has paged through an elementary text-book of physiology, or will regard the acquisition of it as a slight and unimportant consideration. The youthful fondness for the most abstract and least soluble problems should be decidedly suppressed as regards the study of psychology; and, before such a student can at all profit by Professor James's volumes, he must have successfully outgrown this earlier stage. Then, again, the extreme eclecticism regarding the points considered would hardly be rightly interpreted by the student. The order of topics is also unpedagogical; but the author suggests in the preface a changed order, with omission of certain chapters, which would partly remedy this defect. Furthermore, the great size of the work renders it unsuitable to college purposes. There is no attempt at condensation or suppression. One feels that the writer is taking all the space that he wants, and fashioning his exposition of a topic according to his personal interest in it. One obtains very frequent glimpses of the personality of the author; and the text and footnotes, with their frequent witticisms and telling phrases, are about as unlike the ordinary text-book strain as could be imagined. It will be mainly to the teacher, and to those preparing to be teachers, that this work will appeal, and to them mainly as a reference-book for inspiring views of a few topics.

Psychology teaches that the proverbial odium attaching to comparisons is irrational, and that this is a legitimate and useful method of forming a judgment. Accordingly, it will be fitting to compare this new work with former attempts at a survey of modern psychological doctrines. It more immediately invites comparison with the works of Wundt and of Ladd. It lacks the completeness and patient collection of facts characteristic of both these works: it forms a marked contrast to them in the clearness and interest of its expositions. The student is repelled by Wundt or Ladd, but will be attracted to James. It shares in common with Wundt's work, what is perhaps the greatest defect of Ladd's, in giving the reader an impression of originality, coupled with sincere enthusiasm on the part of the author. It is less fitted than either to be the basis of a course in psychology, and is much more than these an expression of personal views and interests. This may suffice to indicate the probable sphere of the work, and to suggest to the reader how far and in what way the work may answer his needs; and we can certainly echo the sentiment expressed by the author in his preface: "But *wer Vieles bringt wird Manchem etwas bringen;* and, by judicious skipping according to their several needs, I am sure that many sorts of readers, even those who are just beginning the study of the subject, will find my book of use."

The Theory of Determinants in the Historical Order of its Development. Part I. By THOMAS MUIR. London and New York, Macmillan. 8°.

PROFESSOR MUIR'S treatise on the theory of determinants is well known, and it may interest our readers to know that a new and greatly enlarged edition of the work is in course of preparation. Part I., which is before us, is devoted especially to a history of determinants in general, from Leibnitz in 1693 to Cayley in 1841. Every one is familiar with the tendency to overrate the influence of a few great minds on the progress of any science. It is easier for the students of a science to look up the work of those with whose names they are most familiar; and from lack of confidence, they feel obliged to overlook the more obscure workers, even if they know of their existence.

In the book before us Professor Muir has attempted to round out the history of determinants by bringing forth in their true relations the contributions of all those who have taken part in the

Publications received at Editor's Office, Sept. 15-Oct. 4.

AMERICAN Household Magazine. Vol. I. No. 1. *m.* Philadelphia, Amer. Household Mag. Co. 16 p. f°. 50 cents per year.
CANADA, Proceedings of the Royal Society of, for the Year 1889. Vol. VII. Montreal, Dawson Bros. 491 p. 4°.
CÓRDOBA, Actas de la Academia Nacional de Ciencias de la República Argentina en. Tome VI. Buenos Aires, Academia Nacional. 1027 p., plates. f°.
DAUCHY & COMPANY'S Newspaper Catalogue, 1890. New York, Dauchy & Co. 623 p. 4°.
HARDY, I. Elementary Composition Exercises. New York, Holt. 169 p. 12°.
INGALLS, J. M. Handbook of Problems in Direct Fire. New York, Wiley. 389 p. 8°. $4.
JAMES, W. The Principles of Psychology. 2 vols. New York, Holt. 1394 p. 8°.
MONIST, The. Vol. I. No. 1, October, 1890. *q.* Chicago, Open Court Publ. Co. 160 p. 8°. $2 per year.
SCHURMAN, J. G. Belief in God: its Origin, Nature, and Basis. New York, Scribner. 266 p. 12°. $1.25.
SMITH, G. J. A Synopsis of English and American Literature. Boston, Ginn. 125 p. 8°. $1.20.
SMITH, J. B. Contribution toward a Monograph of the Insects of the Lepidopterous Family Noctuidæ of Temperate North America.—Revision of the Species of the Genus Agrotis. (Bull. U. S. Nat. Mus., No. 38.) Washington, Government. 237 p. 8°.
U. S. NAVY DEPARTMENT. A Year's Naval Progress. Annual of the Office of Naval Intelligence. June, 1890. Washington, Government. 423 p. 8°.
WEBSTER'S Address at the Laying of the Corner-Stone of Bunker-Hill Monument, with a Sketch of Webster's Life. Boston, Ginn. 23 p. 12°.
WIECHMANN, F. G. Sugar Analysis. New York, Wiley. 187 p. 8°. $2.50.

development of the theory, whether great or small. For many years the theory seemed to belong especially to German mathematicians; but the author believes that he has overlooked little of importance, and that he has been impartial in his treatment of the subject.

An Introduction to the Logic of Algebra. By ELLERY W. DAVIS. New York, Wiley. 8°. $1.50.

As the author puts it, this book is precisely described by the title, and is mainly the outgrowth of a conviction that the logic of algebra is a very much neglected study. We believe it to be the conviction of many teachers of mathematics that one trouble with students in failing to understand the subject is that they look too far. Each step in mathematical reasoning is simple in itself, and the difficulty comes in in deciding what shall be the next step in any process of mathematical reasoning.

Professor Davis, who is, by the way, the professor of mathematics in the University of South Carolina, has certainly produced a unique book, and one that will be of great interest to teachers of algebra; but the question naturally occurs to one that possibly he may have made to appear complicated what heretofore has been more or less readily accepted by students. It is quite true that the processes of algebra are simple and easily taught, and that they are taught mainly for the sake of the processes rather than for the sake of the discipline,—that is, they are taught for the uses to which they may be put,—and it is to be feared that if too much attention is paid to the reasoning which underlies the processes, which has been generally slurred over or even absolutely ignored, the student may think there is more in it than there really is, and become correspondingly confused.

AMONG THE PUBLISHERS.

THOSE having young persons in their charge whom they would interest in science should write to Gustav Guttenberg, care of the Central High School, Pittsburgh, Penn. Mr. Guttenberg carries on by correspondence classes in the study of mineralogy, and has just issued the "third grade," as he calls it, of his "Course." This pamphlet is especially devoted to the determination of ores. The methods of determination by blowpipe analysis are treated of in the first part of the book; and the closing chapters are devoted to the determination of the minerals in Collection 3, so called, which contains thirty or forty specimens sent out in a neat wooden box about seven inches square by an inch and a half deep. Those older persons who are anxious to develop some hobby will also find something of interest in Mr. Guttenberg's courses.

—Joseph M. Wade, Columbia Street, Dorchester, Mass., in his prospectus of *Occultism and Theosophy*, says, "This is the name of our new magazine, which is the outgrowth of *Truths of Nature*, and practically a continuation of that magazine. With increased experience, the editorial lines will be more carefully drawn, as it is intended that the magazine shall aid the earnest seeker after nature's truths, and point the way to the attainment of a pure, spiritual life, as defined in nature's teachings. It will define theosophy proper as against organized sectarianism, and not enter the field of the spiritual and 'Theosophical' papers now published; but it will chronicle and explain, as far as possible, the higher phenomena of spiritual life. It will point the way, and give the key for the development of the spiritual man as against all illusions, and teach absolute peace under all conditions."

What the exact meaning of this may be is left to our readers to decide.

—The October number of the *New England Magazine* is first and foremost a cotton centennial number. The two principal illustrated articles are on "Pawtucket and the Slater Centennial" and "The Cotton Industry in New England." The agricultural interest, to which so much attention was paid in the last number of this magazine, receives further attention in three articles in the present number; a general article on 'Agricultural Education," by Mr. Reeve; an illustrated article on the Massachusetts Agricultural College, by President Goodell of the college; and a story entitled "John Toner's Scheme."

—The current (Oct. 4) issue of *Architecture and Building* is devoted to the study of schoolhouse architecture from both the point of view of the teacher and the architect. The issue contains twenty-one different designs by architects who have achieved distinction in designing buildings for school purposes. The number contains sixteen double-page plates.

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Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—To purchase a complete set, or single numbers, of Loomis' contributions to meteorology, published in the *American Journal of Science.* Address communication, stating price, to FRANK WALDO, Mountain Lake Park, Garrett Co, Maryland.

COULD some one inform me what the ingredients and origin of asphalt as used for street-paving and gathered at Trinidad are? Also how gathered and shipped by natives, and mode of refining by the Warren-Scharf Co. of New York and the Barber Co. of Washington? G. KNIPER, 28 Gunn Block, Grand Rapids, Mich.

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PROFESSOR W. M. DAVIS, Harvard College, Cambridge, Mass., desires to correspond with professional and amateur photographers, from whom he can obtain views of New England landscapes

WANTED.—Advertisements of text-books and good standard works on Natural History, for stocking a library. Add price. Address M. D. SULLIVAN, St. Louis University, St. Louis, Mo.

WANTED—Index to Vol. VIII. and a copy of No. 205 of SCIENCE. Ten cents will be paid for a copy of either of these if in good condition. Publisher of SCIENCE, 47 Lafayette Place, New York.

TO PRINCIPALS OR COMMITTEES.—Professor of Classics and Sciences, experienced in advertising and building up schools, now employed, desires change. WILLIAM, Roslyn, L. I.

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Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

To exchange, 1890 Seeger and Guernsey Cyclopedia, containing a complete list of the manufactures and products of the U. S., and address of first hands, cost $6. David R. Lewis, Saybrook, Ill.

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I wish to exchange a fresh and complete set of Weiss and Spier's "Necropolis of Ancon" for other books, either new or second-hand, if the latter are in good condition. What have you to offer? Address Warren Watson, Kansas City, Mo.

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

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PLANS AND WORK AT CLARK UNIVERSITY.

THE commencement exercises of Clark University, which marked the opening of its second academic year, were held in the large hall of the university building, Oct. 4, 1890. About one thousand persons were present. Stephen Salisbury, Esq., presided, and made an opening address. The address of President G. Stanley Hall was as follows:—

"When called upon to consider the invitation with which the trustees of this university honored me, two and a half years ago, I was in an institution which, in the less than fifteen years of its existence, had done a work in stimulating other institutions, and in advancing the highest standards, which was, as I think all cheerfully admit, beyond comparison in the recent history of higher education in this country. After studying Worcester and the New England situation, I saw the opportunity here to be so great for a further and no less epoch-making step, that I felt that assured career, and even an important department, new in this country and full of fascinations, and in the most critical stage of its development, ought not to weigh against it. Permission was at once given me to begin my preparation for this important work by studying foreign institutions for a year. I visited every European country but Portugal, and found everywhere great and surprising advances since my own student life abroad had ended.

"In France the best and most original professors had been selected from among the various higher institutions of Paris (the Sorbonne, the College of France, Ecole Normale, and the great special institutes), and organized by the government into a new and still higher institution devoted to the most advanced work, and largely to research. This institution, the Ecole des Hautes Etudes, has some features of the French Academy, and adds to these lectures and the personal guidance and inspiration of the most advanced and able students from the other scientific institutions of the country. The new *conseil superieur*, composed of statesmen and professors of the highest standing, which has the chief control of the national system of education from primary school to university, might almost be described as a new educational academy, with vast administrative responsibilities.

"The remarkable new school for the post-graduate training in statesmanship, which, although a private institution, is training the political leaders of all parties; the new law of 1878, basing all clinical and practical medical studies upon the sciences which underlie them (chemistry and the various branches of biology); the Musée Guimnet, which two years ago opened its extensive museums and libraries, and now offers facilities for the study of comparative religion unequalled in the world; the progressive decentralization and local organization of primary education (the sagacious policy of Minister Buisson); the development, by government and otherwise, of what may be called the pedagogy of high education; and the great fact that in fourteen years the total amount devoted to education in that country has increased sevenfold,—all this shows how far, in the words of a distinguished French statesman, 'education is fast becoming the central question for France.'

"In Italy a council of education, composed of sixteen royal appointees and sixteen professors selected from the universities, has grappled with the problem of subordinating fourteen of its universities to the other seven, which latter are being rebuilt with great and sometimes literally palatial magnificence. As, with the policy of doubling for each provincial university all the funds it can raise for itself, the government has gradually acquired practical control of all of them, scholarly and scientific activity has been awakened to new life in nearly all directions, and ambitions of intellectual leadership, as in the best days of the mediæval universities of Italy, are often manifest.

"Holland has revised and co-ordinated her organizations of higher education, and established one new university. Sweden has profoundly reconstructed her educational system on a plan that might be called the most severely modern in the world, and Denmark is taking steps in the same direction. In 1884, Russia, after prolonged discussion, re-organized her universities. In Great Britain, new provincial universities, and important changes in the others, too many and great to be briefly described here, have been inaugurated. In Germany, thirteen magnificent university buildings make Strasburg, in all departments, the best of all architectural embodiments of the German university ideal. Halle and Kiel have been, and Breslau is now being, almost entirely rebuilt. New and often magnificent laboratories, libraries, special cliniques, and museums at every seat of learning,—great temples of science, as they were called by one of its perfervid orators, Du Bois-Reymond,—and two single buildings costing four million dollars each, show where much of the French indemnity money has gone; and, what is far more important, the internal has not lagged behind the external growth. At Budapesth, Ghent, Aix-la-Chapelle, Helsingfor in Finland, and even in remote Athens, magnificent new structures show in what esteem science is now held, and what still greater things she is yet expected to do. Several institutions of new pattern, like the Naples School of Zoölogy, which now trains the best professors for Germany; the London University, which is solely an examining body, and does not teach,—these and many more show not only how many and strong,

but how differentiated, institutions have become in the field of higher education.

"In my trip, information was sought from every source. Books, reports, and building-plans of many kinds were gathered. Ministers of education, heads of universities, and, above all, leading scientific men, were visited. The information and advice of the latter, always cheerfully given, and in not a few cases in detail and in writing, constitute by far the most valuable result of this trip, and will soon be reported on at greater length. Much of this advice was confidential, and involved personalities; some of it embodies long and fondly cherished ideals of great men, nowhere yet realized; but most of it represents the inner aims, methods, and ideals of the best existing institutions, like those named above, and others.

"The causes and the effects of all these movements and ideals in Europe have been felt in other lands. After long discussion, a new university, to which hundreds of Russian patriots with exiled friends have contributed money, household treasures, and even prayers and tears, was at last founded in Siberia, at Tomsk, and not at either of the chief military centres, where freedom would have been impossible. In Japan one of the most interesting universities in the world has been developed as the centre and instrument of most of the remarkable transformation in that country. In Australia and South America new and vigorous universities have been recently established.

"The new movement is already upon us in this country, and many significant facts show that the resultant interest and opportunity here have never been so great. All such facts and tendencies, and many more, opened a clear and broad field for us at Worcester, and unmistakably defined our work as follows:—

"1. It must be of the highest and most advanced grade, with special prominence given to original research. This our country chiefly lacks and needs for both its material and educational welfare. This is in the current of all the best tendencies in the best lands, and is the ideal to-day of, I believe, about every scientific man, who is able and in earnest, throughout the world. For this our location offers the rarest opportunities and inducements yet possible in this country.

"2. We must not attempt at once to cover the entire field of human knowledge, but must elect a group of related departments of fundamental importance, and concentrate all our care to make these the best possible. Each science has become so vast and manifold that it is impossible to cultivate the frontier of all at a single university. This is more and more recognized abroad, and is still more true under our American system of private endowment than on the European plan, with a national treasury to draw from. If coming universities, instead of supplementing others, will elect each its group of studies, all the gain in economy and effectiveness which skilled labor has over unskilled will be secured in the field of highest education.

"3. For our group we chose at first five fundamental and related sciences. Work in science can be quickest organized. Great libraries and museums, and every thing else that only age can bring, can be dispensed with at first, and a complete outfit of the best apparatus and of all needed books can be gathered in a short time. Again, this is a practical country, and its industries are sure to depend more and more on the progress of science. So far, we have utilized science with extraordinary ingenuity in our inventions, but have done comparatively little to create or advance it. We desired to make a patriotic endeavor to develop American discoverers as well as inventors. Finally, and above all, science, with its modern methods, has become an unsurpassed school of discipline, culture, and reverence.

"4. We must seek the most talented and best trained young men. We must not exploit them, work them in a machine, nor retard their advancement, but we must give them every needed opportunity and incentive. As from hundreds of applicants we have admitted but a very few of the best students, because many would frustrate our plan, so, from the many subjects found in most large universities, we selected five to receive all our care, although later we hope to increase both.

"Mathematics is often called the queen of all the sciences. As the latter become exact, they approximate it, and are fructified by its spirit and its methods. Its antiquity, its disciplinary value, its rapid and recent development, make it obviously indispensable. Physics is the field of the most immediate application of mathematics, and deals with the fundamental forces of the world,—heat, sound, light, electricity,—and the underlying problems of form and motion generally, with their vast field of application in such sciences as astronomy and dynamic geology. Chemistry, with its great sudden development, revealing marvellous order and harmony in the constitution of matter, is rapidly extending its dominion over industrial processes. Biology, which seeks to fathom the laws of life, death, reproduction, and disease, that underlies all the medical sciences, in its broader aspects has taught man in recent decades far more concerning his origin and nature than all that was known before. Psychology, or the study of man's faculties and their education, is a new field into which all sciences are now bearing so many of their richest and best ideas, and now so full of promise of better things for the life of man. These five we must have, and nowhere is man brought so close to the primitive revelation of God in his works.

"We have thus sought in these departments the highest form of what is called the philosophical faculty, devoted to non-professional specialization. We are not a graduate department in which most so called graduate students attend, and most professors conduct undergraduate work. We are not an institution like the Smithsonian, which does no teaching; but our teaching is so ordered that it is a direct stimulus to research, and no one is so able and eager to teach the few fit as a discoverer. We are not an academy of sciences, but we have features of all these, and many more. This work is the most laborious and the most expensive. It is the most all-conditioning and the most central for any and every new departure. An undergraduate department, a medical school, a technical school, and, even still more, specialization in the existing departments, or new ones of any kind, could be developed from this basis with comparatively little labor, time, or expense. But the value of all professional or industrial schools depends on the vigor and dominion of the philosophical faculty, the heart of every true university, from which they derive their life and light, and where knowledge is pursued for its own sake, and for its culture effect on the investigator. We are a school

for professors, where leisure, method, and incentive train select men to higher and more productive efficiency than before.

"Last year college trustees elsewhere found a full half-dozen of our fellows only too attractive for their vacant chairs. But if we can thus relieve college trustees of the difficulties under which they sometimes succumb, in selecting suitable men for professorships, we can also ease them of the great expense of providing advanced courses, and from the temptation of retaining after graduation their best men, who could and should utilize larger opportunities.

"The work of the university began a year ago, in all its departments. During the first part of the year, the work of furnishing and equipment was carried on side by side with lectures and scientific work. Our nearly threescore men (selected in part only from about nine hundred applicants for various positions) included graduates of forty-eight different universities and colleges. The printed register describes the buildings, grounds, and organization of the faculty; the system of docents and fellowships; methods and courses of instruction; and the scientific and literary equipment of each department. During the year twenty-eight professors and other instructors have given thirty-three courses, attended often by other professors. This method of mutual instruction has proven a great and wholesome stimulus.

"In our methods of instruction, stated lectures, which are required by the vote of the trustees, are the smallest part. Elbow-teaching is given in the laboratory, and there is individual and constant guidance of reading, as well as experimentation, if needed or desired. Clubs, conferences, and seminaries are held, where all important literature in a wide field, and in different languages, is read; each man taking a subject, and reading and reporting for the benefit of others. Not only the information, but the insight, criticism, methods, and standpoint of each are pooled for the edification and stimulation of all. The contact between professor and student was never closer, and more avenues were never opened between minds working in the same place and field.

"The most important part of our work is research, and we wish soon to be ready to be chiefly judged by the value of our contributions to the sum of human knowledge. By the unanimous vote of the board of trustees, approved by a unanimous vote of the faculty, the leading consideration in all engagements, re-appointments, and promotions, must be the quality and quantity of successful investigation. This significant step gives us a unique character, and makes most of our problems new ones.

"It seems, and often is, a very simple and easy thing to take a free look at new facts. This kind of investigation may be made by any traveller or intelligent collector of specimens. It is sometimes harder to slightly vary the conditions in well-known fields, and note the concomitant variations in the result. Both these kinds of work are, in a sense, original research. Such are many of the theses for the doctor's degree, not to speak of those that are not published; so that the work of the professors and the students, and the standing of the university and the value of its degree, are unknown. Results must be had without risk of failure. Very different from and above this and all so-called 'analogy-work' are the investigations conducted by the aid of accomplished experts, who have already taken their doctor's degree, and give their entire time to co-operation with the professors. Of these we have had one or more in each experimental department during the year, and with excellent results, for investigation. Risks of negative results, often very important in themselves, must be freely taken, if results of great value are to be attained.

"It is impossible, in untechnical terms, to even speak of the researches undertaken here during the year, although these are the chief work of the university. New minerals in Arkansas, with a book on the petrography of that State; chemical action as affected by electricity in the field of a strong magnet; the crystal structure of isomorphous compounds; the ultimate atomic and molecular constitution of two widely different groups of chemical substances, which is said to establish new and important scientific conclusions; further developments of the non-euclidean geometry; several papers, said to be of great algebraic importance, on matrices; a standard of length in terms of a light-wave one fifty-thousandth of an inch long; a new method of greatly magnifying the power of telescopes, so that possibly the disks of fixed stars may be seen (a method speedily put in operation by the Lick Observatory, with the largest telescope glass in the world); the electrical properties of the air, and a little group of problems in meteorology; the embryology of an animal peculiar to America, and of great importance to the ancestry of vertebrate life; studies of sea-anemone and jelly-fishes; the breeding-habits and embryology of the lobster, strangely unknown before; a third fundamental tissue determined for most organs in the vertebrate body; the discovery of the innervation of veins; the comparative study of organs of taste in many vertebrates; fatigue, studied experimentally and also histologically, in the living cell; the brain of the world-known deaf-mute, Laura Bridgman, more thoroughly studied than any brain ever before has been; the time of the quickest mental and nerve processes; the sense of rhythm, so fundamental to several arts; the myths, customs, and beliefs of the native Indian tribes of British Columbia,—all of these and half a dozen more of less significance, some not yet completed, some already published in several languages, represent some of our work here during the past year, so important that if, instead of marking the beginning of a second year with greater facilities and increased numbers and zeal, this occasion marked the close of the university, the sum of human knowledge would have been larger for our having existed, and we should have our place forever in the history of the advancement of science.

"In addition to this, I do not here mention the marked stimulus we have already exerted on other institutions. In this new country we need new men, new measures, and occasionally new universities; and we, like England, have in later years experienced their amazing good. In the field of experimental science, unlike some other departments, what is there of importance, that a few centuries can afford, that cannot be at least as well provided in a few years? A new institution, in a time and place like the present, manned by young men, ought to become a new movement. Many of our problems are new in this country, and must be wrought out slowly and in the light of all available experience and wisdom.

"Partly to aid ourselves in this work, as well as for our

students, we attempt this year to begin to develop the pedagogy of higher education by a new department, and a new third journal, now about to be issued from the university.

"Finally, although we yet lack all the traditions and enthusiasm that come with age, with what gratitude and earnest felicitation does every mind and heart here turn to a founder who is not a tradition, a picture, a statue, or even a memory, but the living, animating power of the institution he has planted with such wisdom, and watered with such care! As an investigator toils to bless mankind with new discoveries, so he has wrought that the world might be blessed by the more rapid increase and diffusion of truth. As a teacher longs to impart all his knowledge to a favored pupil, so he has been the best of all my teachers in things in which a scholar may sometimes lack wisdom. As parents are anxious for the comfort and highest success of all their children, so he, and his devoted wife, could even be careless of what all others may say or do, if only every man here be so placed, furnished, and incited as to do the best work of which he is capable, for himself and for science. If we labor with his persistence and devotion, his care in things that are small as well as great, we cannot fail to realize his and all our highest hopes and best wishes for Clark University."

THE ARYAN CRADLE-LAND.[1]

"IT will be for the benefit of our science," said the president of the Anthropological Section of the British Association, "that speculations as to the origin and home of the Aryan family should be rife; but it will still more conduce to our eventual knowledge of this most interesting question if it be consistently borne in mind that they are but speculations." With the latter, no less than with the former opinion, I cordially agree. And as, in my address on the Aryan cradle-land in the Anthropological Section, I stated a greater variety of grounds in support of the hypothesis of origin in the Russian steppes than has been elsewhere set forth, I trust that I may be allowed briefly to formulate these reasons, and submit them to discussion.

(1) The Aryans, on our first historical knowledge of them, are in two widely separated centres,—Transoxiana and Thrace. To Transoxiana as a secondary centre of dispersion the eastern Aryans, and to Thrace as a secondary centre of dispersion the western Aryans, can, with more or less clear evidence or probable inference be traced, from about the fourteenth or perhaps fifteenth century B.C.; and the mid-region north-west of Transoxiana and north-east of Thrace—and which may be more definitely described as lying between the Caspian and the Euxine, the Ural and the Dnieper, and extending from the 45th to the 50th parallel of latitude – suggests itself as a probable primary centre of origin and dispersion.

(2) For the second set of facts to be considered reveal earlier white races, from which, if the Aryans originated in this region, they might naturally have descended as a hybrid variety. Such are the facts which connect the Finns of the north, the Khirgiz and Turkomans of the east, and the Alarodians of the south with that non-Semitic and non-Aryan white stock which has been called by some Allophyllian, but which, borrowing a term recently introduced into geology, may, I think, be preferably termed Archaian; and the facts which make it probable that these white races have from time immemorial met and mingled in the South Russian steppes. Nor, in this connection, must the facts be neglected which make great environmental changes probable in this region at a period possibly synchronous with that of Aryan origins.

(3) In the physical conditions of the steppes characterizing the region above defined, there were, and indeed are to this day, as has been especially shown by Dr. Schrader, the conditions necessary for such pastoral tribes as their language shows that the Aryans primitively were; while in the regions between the Dnieper and the Carpathians, and between the Oxus and the Himalayas, the Aryans would, both in their south-western and south eastern migrations, be at once compelled and invited, by the physical conditions encountered, to pass at least partially from the pastoral into the agricultural stage.

(4) The Aryan languages present such indications of hybridity as would correspond with such racial intermixture as that supposed; and in the contemporary language of the Finnic groups Professor De Lacouperie thinks that we may detect survivals of a former language presenting affinities with the general characteristics of Aryan speech.

(5) A fifth set of verifying facts are such links of relationship between the various Aryan languages as geographically spoken in historical times,—such links of relationship as appear to postulate a common speech in that very area above indicated, and where an ancient Aryan language still survives along with primitive Aryan customs: for such a common speech would have one class of differentiations on the Asiatic, and another on the European side, caused by the diverse linguistic re-actions of conquered non-Aryan tribes on primitive Aryan speech, or the dialects of it already developed in those great river partitioned plains.

(6) A further set of verifying facts are to be found in those which lead us more and more to a theory of the derivative origin of the classic civilizations, both of the western and of the eastern Aryans. Just as between the Dnieper and the Carpathians, and between the Oxus and the Himalayas, there were such conditions as must have both compelled and invited to pass from the pastoral into a partially agricultural stage, so, in passing southward from each of these regions, the Aryans would come into contact with conditions at once compelling and inviting to pass into a yet higher stage of civilization. And in support of this all the facts may be adduced which are more and more compelling scholars to acknowledge that in pre-existing Oriental civilizations the sources are to be found, not only of the Hellenic and the Italic, but of the Iranian and the Indian civilizations.

(7) Finally, if the Hellenic civilization and mythology is thus to be mainly derived from a pre-existing Oriental or "Pelasgian" civilization, it is either from such pre existing civilizations, or from Aryans such as the Kelto Italiots, migrating northward and southward from Pelasgian Thrace, that the civilization of western and northern Europe would, on this hypothesis, be traced: and a vast number of facts appear to make it more probable that the earlier civilization of northern Europe was derived from the south than that the earlier civilization of southern Europe was derived from the north.

The three conditions of a true solution of the problem either of Semitic or of Aryan origins appear to be these: first, the locality must be one in which such a new race could have ethnologically, and secondly philologically, arisen as a variety of the Archaian stock of white races; and, thirdly, it must be such as to make easily possible the historical facts of dispersion and early civilization. And I venture to submit the above sets of facts as not inadequately, perhaps, supporting the South Russian "speculation as to the origin and home of the Aryan family."

J. S. STUART GLENNIE.

[1] From Nature of Oct. 2.

ETHER INTOXICATION.

WE can bear out from personal observation, says the *Lancet* for Sept. 20 editorially, many of the statements which are now going the round of the public press in reference to the habit of ether-drinking in some parts of Ulster; for, in fact, some of the paragraphs are nothing more than copies of what have been reported in years gone by. The practice came into use about the year 1841–42, and was at first a kind of re-action against the great temperance movement which had been inaugurated by Father Mathew. Ether, at that time of the ethylic type, probably not very pure, was substituted for whiskey; and the habit, commencing in or near to Drapers Town and spreading over a small surrounding area, is continued up to the present day. The order of drinking, as witnessed during a visit to the dictrict named, is singular. The

ether purchased at open shops and at stores was doled out in wine-glasses. The drinker first washed out his mouth with a draught of cold water, and after that tossed off a wine-glassful of ether "nate," as it was said, drinking it quickly, almost at a gulp. Both men and women took part in this indulgence, and were speedily brought into a state of intoxication more or less complete The intoxication differs from that produced by alcohol. It is more rapidly induced, and more rapidly dispelled: in fact, the effect of one dose may be developed and cleared off in a quarter of an hour or twenty minutes. The delirium is sharp; the stupor, for a brief period, deep; and the excitement, so long as it lasts, hysterical.

Particulars were gathered from a trustworthy medical source of several instances in which the narcotism caused by the ether had proved dangerous, calling for the employment of artificial respiration; and evidence was found of four actually fatal intoxications, either from an excessive dose, or from asphyxia caused by the entrance of some of the fluid into the glottis, with succeeding spasm or obstruction. It was gathered, at the same time, that tolerance to the effects of ether was much less marked than tolerance to alcohol; and that organic disease from the habitual taking of ether was exceedingly small compared with the ravages and degenerations which alcohol leaves in its train. The explanation of these facts is not difficult: alcohol is so soluble that it enters the blood freely; pervades, with the water of the blood, all the tissues; and is readily retained by them to work out those serious osmotic changes which demonstrate its action as the most potent of degenerators. Ether, on the other hand, is comparatively insoluble; and as it boils at the temperature of the body, and is diffused nearly as fast as it is introduced, it leaves few marks of mischief, except when it destroys life directly. Occasionally it gives rise to dyspepsia and to gastric irritation, with free eructations of gases mixed with etherial vapor. But these symptoms belong to ether topers of a hardened sort, and soon pass off when the habit is abandoned.

Of late years the use of the cheaper methylated ether has taken the place, to a considerable extent, of the ethylic variety, and some think with more injurious effects; but on this point there is no evidence strictly trustworthy. Officers of the government have at various periods made inquiries in order to see if, by legislative action, the habit could be controlled or prevented; but as yet nothing has been suggested that has promised success, and the excise officers are helpless, inasmuch as the spirit from which the ether is made has paid the usual duty previously to the manufacture.

HEALTH MATTERS.

Leprosy in Spain.

SOME interesting particulars are given by the British consul at Cadiz, in his last report, as to the San Lazaro Leper Hospital, which has been in existence at Seville for over six hundred years, says the *British Medical Journal*. The first leper-house in Spain was founded at Valencia, in 1067. The San Lazaro Hospital was founded by Ferdinand III., when he took Seville from the Moors, in 1248. It is situated about a mile to the north of the city. A decree was issued in 1478, confirming previous enactments to the same effect: "That all persons without distinction residing within the Archbishopric of Seville and the Bishopric of Cadiz, denounced and declared lepers, must go to the Hospital de San Lazaro, Seville." This decree was carried out with great rigor. From the reign of Alfonso X., down to the last century, it was the custom for four patients to visit Seville daily on horseback, begging; and, as they were not allowed to speak to ordinary persons, they attracted attention by means of boards. In 1854 the hospital was put under the charge of the Diputacion Provincial: the edifice was then little better than a ruin, and contained only 29 patients. In 1864 the building was repaired. The patients, who number on the average from 30 to 36, are looked after by sisters of charity. From the official reports it appears that the patients are not all lepers, cases of cancer and other diseases being admitted.

Cremation at Milan.

Two systems of cremation are followed at Milan, by one of which the body is burned in a furnace surrounded by wood and charcoal, while by the other the combustion is brought about through a number of jets of gas which cast their heat upon the furnace from all sides. When wood and charcoal are employed, as stated in the *Medical Record*, about six hundred pounds of wood and one of charcoal are found necessary, and the process lasts two hours. When gas is used, all that is consumable in the body is burned up in less than fifty minutes. The body may, in ordinary cases, be introduced into the furnace with or without the coffin; but, if death has been caused by some infectious disease, the coffin and body must be burned together. The weight of the remains after cremation, in the form of bones and dust, is about four pounds. They are in color pure white, tinged here and there with a delicate pink; and it is a rule never to touch them with the hand. The bones, and vestiges of bones (which are for the most part burned into powder), are taken up with silver tongs, while the ashes are removed from the furnace with a silver shovel, to be placed on a silver dish, and then deposited in an urn for retention in the cinerarium. Here the ashes are preserved in separate compartments, each with a suitable inscription beneath it The cost of cremation is five dollars to a member of the Society for Extending Cremation in Italy, or ten dollars in the case of non-members.

Child Suicides.

The *Medical and Surgical Reporter* is authority for the statement that from Jan. 1 to Sept. 1, 1890, 62 children—46 boys and 16 girls—committed suicide in Berlin. Of this number, 24 had attained the age of fifteen, 14 their fourteenth year, 9 their thirteenth, while 7 were only twelve years of age, and one had not attained the age of seven. In most of the cases the immediate cause for the act remains a secret, but it is supposed to have been due to exceptional severity on the part of servants or teachers.

Malarious Africa.

Malarial-fever is the one sad certainty which every African traveller must face. For months he may escape, but its finger is upon him; and well for him if he has a friend near when it finally overtakes him. It is preceded for weeks, or even for a month or two, by unaccountable irritability, depression, and weariness, says Drummond in his well-known book. This goes on day after day till the crash comes,—first cold and pain, then heat and pain, then every kind of pain and every degree of heat, then delirium, then the life-and-death struggle. He rises, if he does rise, a shadow, and slowly accumulates strength for the next attack, which he knows too well will not disappoint him. No one has ever yet got to the bottom of African fever. Its geographical distribution is still unmapped, but generally it prevails over the whole east and west coasts within the tropical limit, along all the river-courses, on the shores of the inland lakes, and in all low-lying and marshy districts. The higher plateaus, presumably, are comparatively free from it; but, in order to reach these, malarious districts of greater or smaller area have to be traversed There the system becomes saturated with fever, which often develops long after the infected region is left behind. The really appalling mortality of Europeans is a fact with which all who have any idea of casting in their lot with Africa should seriously reckon. None but those who have been on the spot, or have followed closely the inner history of African exploration and missionary work, can appreciate the gravity of the situation. The malaria spares no man; the strong fall as the weak; no number of precautions can provide against it; no kind of care can do more than make the attacks less frequent; no prediction can be made beforehand as to which regions are haunted by it and which are safe. It is not the least ghastly feature of this invisible plague that the only known scientific test for it at present is a human life. That test has been applied in the Kongo region already with a recklessness which the sober judgment can only characterize as criminal. It is a small matter that men should throw away their lives, in hundreds if need be, for a holy cause; but it is not a small matter that man after man, in long and in fatal succession, should seek to overleap

what is plainly a barrier of nature. And science has a duty in pointing out that no devotion or enthusiasm can give any man a charmed life, and that those who work for the highest ends will best attain them in humble obedience to the common laws. Transcendentally this may be denied; the warning finger may be despised as the hand of the coward and the profane: but the fact remains,—the fact of an awful chain of English graves stretching across Africa.

Hairs as Records of Emotional Disturbances.

Dr. Pineus of Berlin claims to be able, by the aid of the polariscope, to detect certain traces of past emotions in the hairs. He explains, that, under the influence of mental disturbances of a violent kind, the hairs become decolorized at the junction of the lower two thirds with the upper third, reckoning from the surface of the skin to the root of the hairs. The observation, if exact, is interesting, but the recollection of such emotions is generally too vivid to render any artificial aid to memory necessary. If Dr. Pineus could only devise a means of detecting emotions to come, says the *Medical Press*, his *procédé* would excite a vast deal more curiosity.

NOTES AND NEWS.

IN the course of an article on recent progress in Egypt, the London *Times* says, "Both Egyptians and English are now alive to the need of educational progress. The people are no longer apathetic, as they were in the days of Mehemet Ali, who collected his pupils by force as he did his conscripts, and only kept them together by giving them food, lodging, clothing, and a monthly money payment of considerable value. Parents no longer believe the Koran contains every thing, or, rather, that what it does not contain is worth nothing. They are not yet alive to the advantages of trade or handicrafts, but they are fully alive to the advantages of government employment; and even in the villages a better class of education is urgently demanded. But want of funds stops the way. A general system of sound elementary education throughout the country would be one of the greatest blessings the English could confer; but it would cost money, and it cannot be done. All attention is concentrated on the higher schools in the big towns and in Cairo. You might as well try to build a pyramid without a base. Then, again, there are no teachers to teach the pupils. Inspection of such teaching as there is, and the establishment of normal schools for the training of the teachers of the future, are sadly wanted. Although the obvious duty of the English is to produce a class of Egyptian teachers, still the higher schools must remain for some time in the hands of professors from Europe. The educational system does not look so bad on paper. There are over 7,000 schools in the country, and 7,764 teachers; but the teaching is miserable, and out of a population of nearly 7,000,000 of people, only 200,000 can read and write."

— In Austria there is not only a high school of agriculture, costing the state 125,000 florins a year, but there are fifteen intermediate and eighty-three primary agricultural schools, besides nine chairs of agriculture in polytechnic establishments and agricultural experiment stations. Moreover, as stated in the London *Educational Times*, there are 162 courses of agricultural lectures, attended, on an average, by about 10,000 persons a year. The whole expense of agricultural subventions is set down in the Austrian Estimates for the present year as 1,777,034 florins.

—At a meeting of the International Meteorological Congress, held in Paris last September, the Rev. Father Denza read a paper on "The Decrease of Temperature in the Vertical Line." According to the figures he produced, the annual mean ascent required to obtain a decrease of one degree of temperature was 150 metres in the valley of Aosta, and 191 at Moncalieri (Monte Cenis), while 192 was the mean for the whole of Italy. At Pike's Peak, Colorado, 159 metres is the height required. In the winter months the heights in the valley of Aosta and at Moncalieri are 189 and 375 respectively, and 289 is the mean for Italy. It frequently happens that the temperature rises until a certain height is reached, and then decreases. This was particularly noticeable in January, 1887, when the temperature increased up to 700 metres (about 2,300 feet), and then diminished according to the ordinary law. The barometric pressure was high, the air dry and calm. This phenomenon was confirmed by observations referred to by other members of the congress, and Père Dechevrens pointed out the necessity of taking the barometric pressure into account in comparing changes of temperature in the vertical. In China, at an observatory situated on a mountain in the midst of a vast plain, a rise of ten degrees of temperature is always observed for a fall of 20 millimetres in barometric pressure; and at Mount Washington, when the wind blows at the rate of 100 miles an hour, the variation of the temperature is thirty degrees for the same decrease of pressure.

— In the Teachers' School of Science of the Boston Society of Natural History, Dr. J. Walter Fewkes will give a series of ten lessons (Lowell free courses) during the winter of 1890–91, "On Common Marine Animals from Massachusetts Bay." The general scope of this course will embrace the ordinary marine animals of New England. It is intended to give special attention to the mode of life, differences in external forms, local distribution, habitats, methods and proper time to collect the eggs, young, and adults. The anatomy, embryology, and morphology of the species considered will be dealt with incidentally, wherever these branches of research can be used advantageously. The introductory lecture will give an outline of the course. The relative abundance of species and individuals, local causes which influence distribution, the rocky or sandy nature of the shores and their characteristic faunæ, and the influence of depth of water, tides, and temperature, will be considered. The relations and boundaries of the marine fauna of New England will be treated of under the following headings: comparison of the fauna of Massachusetts Bay with that of Narragansett Bay and the Bay of Fundy, and causes of the differences observed; pelagic animals; littoral and shallow-water genera; introduced and indigenous marine animals; marine animals which inhabit both brackish and fresh water. In the remaining lessons the principles discussed in the first lesson will be applied to the life histories of various characteristic species among the lower forms of marine animals. The course will be illustrated as far as possible. For further information address the secretary of the Boston Society of Natural History.

—Writing to *Nature* on the subject of sonorous sand, Mr. Henry C. Hyndman asks whether Professor H. C. Bolton is aware of an inland locality in South Africa, where, it is stated, the sands are sonorous. In a recent letter to the *Scotsman*, Mr. Hyndman mentioned that he had come across a paragraph in a work entitled "Twenty-five Years in an African Wagon," by Andrew A. Anderton, published in 1887, in which the author said, "Before leaving this part of the Griqualand West, I should like to describe that peculiar sand formation on the west side of the Langberg Mountain, which is in fact part of it. I heard from many of the Griquas and Potgielet living near it, that the lofty hills are constantly changing; that is, the sand-hills, 500 and 600 feet in height, in the course of a few years subside, and other sand-hills are formed where before it was level ground." And then in a footnote it is added, "I regret very much that the description of this sand formation has been left out, it being the only extraordinary geological formation known in Africa, and fully describes the musical sand."

— A means of easy intercommunication between writers, editors, and publishers has long been needed. To supply this need, the editor of *The Writer*, the Boston magazine for literary workers, has undertaken to compile a "Directory of American Writers, Editors, and Publishers," which will be published at the earliest possible day. No charge whatever will be made for the insertion of names and addresses in this directory, the usefulness of which, particularly to editors and publishers who wish to communicate with writers, will be evident at a glance. The desire of the editor is to make the directory as nearly complete as possible, but the army of minor writers is so great that it will be necessary to limit the number of addresses in some reasonable way. It has been thought best, therefore, to include in the first edition only the names of writers who have had a contribution printed in some one of the leading magazines or weekly periodicals during the last five years, or who have had a book published within the

last ten years. Writers who are included in either of these classes are requested to send at once to the editor of *The Writer*, P. O. Box 1905, Boston, Mass., the following items of information: (1) name of writer; (2) present residence; (3) permanent business address; (4) literary specialty; (5) titles of principal articles or books printed, and dates of publication. This information should be sent promptly, for the directory has been for some time in preparation, and its publication will not be long delayed. The editor of the directory will be obliged, if, in addition, writers will send on a separate sheet, not for publication in the directory, autobiographical particulars, including date of birth, place of birth, parents' names, date of marriage, name of husband or wife, successive places of residence, title and date of first work printed, list of later works, and other such matters as would be suitable for publication in a "Biographical Dictionary of American Authors," now in course of preparation. By the prompt co-operation of those who are interested in the matter, the early publication of the directory may be secured.

— Mr. John E. Nowers of Burton-on-Trent writes as follows on the tenacity of life in a cat, in Hardwicke's *Science Gossip* for October: "A very severe accident to a cat came under my notice about two years ago. The cat was in the habit of catching mice under a machine for lowering casks into a brewery cellar. One evening it was working, and the first hogshead of ale was rolled on and lowered. When it reached the bottom, the screams of an animal attracted the attention of the man. He looked, and found the cat was trapped between the edge of the cage and the floor. She was caught across the loins, and had to remain in that position until he called another man to help him up-end the hogshead. If he had rolled it off, it would have smashed the cat to atoms, as its weight was about six hundredweight. When the cat was released, she crawled away, and they could not find her again that night. Next morning she was found in the cellar alive, and brought up to me. I examined her, and could not find any bones broken, but she could hardly move. I decided not to kill her, but try and bring her round, so made a bed in a warm corner of the engine-room. She lay there for three or four days in a very weak and bad state. In about a week she had three dead kittens, and then began to recover rapidly. For a few weeks she could only limp a short distance from her bed. She is still alive, and no one would notice by her appearance that she had ever been so badly hurt. Since that time she has had about eight kittens. She is very quick in all her movements, and a very keen mouser. When I read the note on the same subject in *Science Gossip* for July, I thought the above might interest some of your readers."

—The monthly report of Arthur Winslow, State geologist of Missouri, shows that during the month of September detailed mapping has progressed uninterruptedly in the coal-fields in Randolph, Chariton, Howard, and Johnson Counties, and in the south-east in St. François and Iron Counties. About a hundred and fifty square miles have been covered. The examination of the clays and structural materials of Kansas City and of the tributary country was begun about the middle of the month, and work has been done in both Jackson and Henry Counties. There are in and about Kansas City some thirty-two works engaged in the manufacture of clay products, and from fifteen to twenty quarries. The country about this city, including Henry and other counties, has valuable deposits of clays and other structural materials which are supplied to Kansas City and other points: hence, from Kansas City as a centre, will properly be made an examination of a large portion of western central Missouri. In connection with this line of work, inspections have further been made of clay deposits and works in Callaway and Audrain Counties. The examination of the mineral waters of the State has been actively pushed in the field during the past month. About thirty localities have been visited, and some twenty samples for analysis have been collected from the following sixteen counties: Monroe, Audrain, Callaway, Boone, Howard, Randolph, Livingston, Worth, Gentry, Nodaway, Buchanan, Platte, Clinton, Clay, Adair, and Jackson. As this work progresses, the importance of the subject is constantly developing. A very large amount of capital has been invested in improvements at numerous of these springs in the State, and many of them have a large patronage. There is evidence that the waters at many places are of decided therapeutic value, though a determination of their compositions is necessary to fully substantiate this. Paleontologic work has been in progress in Henry, St. Clair, Polk, and Greene Counties, and large additions have been made to the collections of the survey, besides what has been gathered for study through the co-operation of the United States Geological Survey. During the latter half of the month, work has been done in classifying, labelling, and arranging specimens for exhibition in the cabinet of the survey. Besides this systematic work, inspections for special purposes have been made in Camden, Laclede, St. Clair, Randolph, and Callaway Counties. The work in the coal-fields has already progressed far enough for it to be apparent that the coal-lands at present under development represent only a small portion of the whole, and that many farms and other lands contain beds which should prove valuable possessions to their owners. These lands offer a promising field for investment; and that this fact is appreciated by those who have knowledge of the ground, is evidenced by the extent to which such lands in some sections are passing into the control of investors and companies.

—The Manchester (England) Steam Users' Association has issued a report on a series of experiments made with a view of ascertaining the result of injecting feed-water into a boiler when the boiler is short of water, and the furnace is red-hot. It has for long been a common belief among engineers that many boiler explosions are due to this cause; and to the same cause have been attributed accidents to domestic circulating boilers which have been allowed to run dry, and have then had cold feed-water admitted. The correctness of this belief has, however, for some time been doubted, and the elaborate series of experiments recorded in this report go to prove that it is altogether erroneous. As described in the *Journal of the Society of Arts*, London, a Lancashire boiler 27 feet long was fitted up for the purpose of the experiments, so that the condition which it was desired to investigate could be reproduced, while observations could be taken of what was going on within the boiler. These experiments were by no means free from danger, and an observatory had to be constructed near the boiler. As a result, it was found that the sudden injection of the cold feed did not cause a rapid generation of steam, and a sudden violent pressure which the boiler in its weakened condition could not stand. In some cases, indeed, the pressure was slightly raised; but it always fell immediately afterwards, and in some cases the cold feed at once lowered the pressure. The writers of the report even think that it might be advantageous in cases where the water has been allowed to get very low, and the furnace-crowns to become heated, to turn on the feed, though they hesitate, in the present state of knowledge on the subject, to recommend such a proceeding.

—The London *Times* prints statistics, compiled by the Lyons syndicate of silk merchants, respecting the production of silk in the world last year. The figures are, of course, merely approximate, for the results of the harvest in the interior of China, Japan, India, Persia, and the Caucasus, cannot be absolutely estimated. If it were possible to get the exact figures of the production in these comparatively unknown regions, it is not an exaggeration to say that the general silk-production of the world would be found to be double what the figures show it to be now. The syndicate has no interest in securing definite information concerning these remote districts. It is sufficient for commercial purposes to obtain the returns of the European harvests, and those districts of the Far East which supply European and American manufacturers. The syndicate estimates the general production of silk in 1889 at 11,706,000 kilos. For the previous four years the figures were as follows: 1888, 11,548,000 kilos; 1887, 11,888,000 kilos; 1886. 10,554,000 kilos; and 1885, 9,002,000 kilos. The average of the four years 1885 to 1888 being 10,748,000 kilos, it will be seen that the production of 1889 considerably exceeds the average. This result has been obtained notwithstanding the deficiency in the European harvests, owing to the improvement in the Levant district, notably Syria, and especially in the larger Asiatic arrivals.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

Vol. XVI. NEW YORK, October 17, 1890. No. 402.

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LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Espy's Experiments.

Professor Ferrel's letter in *Science* of Oct. 3 emphasizes some of the points that I have insisted upon in regard to the distinction which should be made between meteorologic facts and theories. Professor Ferrel clearly sets forth the fact that such theories depend upon "physical constants," such as "the mechanical equivalent of a unit of heat, the specific heat of air, the latent heat of aqueous vapor, the tension of the aqueous vapor of saturated air at any given temperature," etc. I have tried to show that starting from such facts, and elaborating a theory which shall account for such complex motions as we meet with in our storms, is certainly very interesting; we do not agree, however, as to whether it is profitable or not. That the results of Espy's experiments do not enter into modern theories will be a surprise to some, I think. I have tried to show that no one, so far as I knew, had tried Espy's experiments or shown that they could be applied to storm conditions as they are now familiar to us. Of course, a score of physicists, more or less, have theorized upon the subject.

May I suggest that I have never contended that latent heat is not set free on condensation of moisture? My whole effort has been to determine the sufficiency of Espy's experiments in establishing the view that there is an uprush of air in our storms, which is increased by the liberation of latent heat from condensation, etc. It seems to me that if all other views regarding his researches prove faulty, the single fact that he used an expansion which was equivalent at times to a rush of air at ten thousand feet per second,—an absolutely incredible velocity for our uprushes,—would be well-nigh fatal to his deductions. In repeating Espy's work, I simply attempted to carry on a research which should in some measure be comparable with natural phenomena. Expansions at the rate of five hundred and a thousand feet per second are certainly far greater than any that we can consider as occurring in our storms. I hope shortly to repeat my experiments with improved apparatus, and determine, if possible, a few points in Espy's work that are not quite plain. Professor Ferrel himself shows that these very researches of Espy were faulty, and this corroborates in some measure my results.

Finally, Professor Ferrel calls attention to the deduction that I have made, that compressing air ten inches, without the loss of heat, would heat it 163°, and gives 43° as the true temperature. My deduction was based upon the facts presented by Professor Tyndall on the sixty-sixth page of "Heat as a Mode of Motion." I find I have mistaken Tyndall's meaning. This computation does not seem very simple One of my friends, a physicist, gives me a very different value from Professor Ferrel's. The simplest computation would be in the case of a cooling after a compression, and after the compressed air has attained the outside temperature. I feel sure, that, if Professor Ferrel will make that computation, he will see at once that his temperature of 45° cannot be correct. The problem seems quite complex, and I would be very glad to have some one familiar with such problems work out a solution. The problem is this: What will be the rise in temperature in a mass of air at atmospheric pressure if its pressure is increased without the loss of any heat; the increase of ten inches to be considered after the air has cooled to its initial temperature? May I call Professor Ferrel's attention to a single point which he seems to have overlooked, or regarded of little importance? It is this: if we consider that Espy, after compressing the air, waited until it attained the outside temperature before explosion, the resultant cooling after expansion cannot be compared in any way directly with the heating produced by compression and without the loss of heat. Moreover, it is impossible to determine, by Espy's work, the amount of the previous heating, from the cooling after explosion.

H. A. Hazen.

Washington, Oct. 4.

Deaf-Mutes and their Instruction.

By a deaf-mute is understood one who is born deaf, or lost his hearing before the acquisition of speech, and in consequence thereof is mute. Deafness may be divided into two classes; viz., congenital and acquired. Acquired deafness admits of four subdivisions:—

A. Where hearing has been lost before the acquisition of speech.

B. Where vowel hearing alone is retained.

C. Where the hearing has been lost after the acquisition of speech, but the latter imperfectly retained.

D. Where the hearing has been lost and speech retained, but the individual lacking education, and precluded from training in common with hearing children.

Those described under *C* and *D* are designated as "semi-mutes." Over fifty per cent of the total number of deaf-mutes are of the acquired form. Children who lose their hearing at the age of three or four years are apt to forget speech within about a year's time, unless intelligent parents endeavor to retain and cultivate it. The hearing is more essential to intellectual development and enjoyment than any other sense. Without education, a deaf-mute is entirely debarred from the acquisition of spoken language, the noblest product of the mind. It is true, necessity, the mother of invention, impels one thus affected to invent a language of natural signs to communicate with his fellow beings; but he is not enabled to express or receive abstract ideas through this medium.

Intercourse under these circumstances is necessarily limited. The absence of hearing power makes the individual more dependent upon his other senses, which consequently acquire a high degree of development and acuity by constant practice. Sight, touch, and general sensation take the place of the lacking sense, in addition to performing their inherent physiological functions, in the acquisition of mental training and knowledge. Observers will note that the gaze of the deaf-mute wanders from object to object, interrogating them as to their significance. The conclusion drawn from such an inspection depends for correctness upon the reasoning faculties and intellectual vigor of the individual. In general, the uneducated deaf-mutes recognize a difference between right and wrong; not the moral right and wrong in the full sense of the expression, but sufficient to enable them to evade coming in conflict with the law. They are able to perform mechanical labor, and try to make themselves useful. In earlier times, when they were not recognized as responsible beings, they were sometimes employed at services where secrecy was desirable, as the law did not recognize them as witnesses, even in their own behalf. As a consequence of frequent misunderstandings with their fellow-beings, they are apt to become quick-tempered. Some drag and shuffle their feet in walking,—a habit due to their infirmity and the want of education. The general sensation of deaf-mutes is very acute; and it is very seldom that we hear of a deaf-mute being run over by vehicles, or meeting with kindred accidents, in this great metropolis. Their manners, morals, and understanding will depend largely upon their associates. Despite the fact that uneducated deaf-mutes have given evidence of a high order of intelligence, they were not recognized as rational beings by the ancients, and were classed with idiots. Our progenitors did not understand the connection between hearing, speech, and thought; and the deaf mutes were denied the capacity of intellectual culture, and were allowed to remain in a deplorable state of ignorance. The first intimation to be found regarding the instruction of this unfortunate class occurs in Rudolph Agricola's works, "De Inventione Dialecticæ." This writer flourished during the close of the fifteenth century. He relates the case of a deaf-mute who could converse by writing. From the sixteenth to the seventeenth century quite a number of cases of deaf-mutes who were educated individually are recorded, some by means of the sign-language, and others by articulation. J. P. Bonnet taught deaf-mutes by articulation, and published his method at Madrid in 1620.

The credit for establishing the first school for deaf-mutes belongs to De l' Epée. This school, established at Paris in 1760, became a state institution in 1791. While this was a momentous step forward in the history of deaf-mutism, the founder unfortunately made the sign-language the basis of his instruction. His idea was, that spoken language is foreign to the deaf-mute, because he cannot acquire it through the same channel as we do (by hearing), and that his natural language is one of signs, because he uses them; and therefore De l' Epée's system develops from the natural signs, which necessity compels the deaf-mute to use, an artificial sign-language, which has no analogy in construction with spoken language, and imparts to the deaf-mute all information in that artificial sign-language, and makes the acquisition of his native language a secondary achievement, as we, for instance, learn a foreign language by means of our mother tongue.

In 1778, Heinricke opened a school for deaf mutes in Leipzig, and made articulation the basis of instruction. Since that time these two systems have been in vogue, and are designated, after their origin, the French and the German system respectively. The German system approaches in principle to the method of nature. A child is made to acquire language by frequent representation of the word to its mind through the sense of hearing. To overcome this obstacle in the deaf child, the word is exhibited to him through the sense of sight, and in a twofold manner,—by articulation and by writing. The word is thus ingrafted upon the mind by two impressions without the intervention of any artificial signs. As a consequence, those taught by articulation share as fully in the possession of a mother-tongue as their more fortunate brethren, excepting that this end is obtained at a somewhat later period in life. They employ it in reflection; and it is the language they dream in (they speak in their dreams as normal individuals), for they are unacquainted with any other. Those taught by signs reflect by means of signs, and translate their impressions into our language when necessity compels them to. Even De l' Epée acknowledges this latter fact.[1] For the benefit of those who are unacquainted with the method of teaching deaf-mutes to speak, I will give a brief illustration. The easiest sounds to begin with are the vowels *a*, *o*, *u* (*a* as in *father*, *o* as in *hold*, and *u* as in *flute*). The teacher writes the letter *a* on the black board, and the child copies it. The pupil then places his hand on the teacher's chest while the latter is in the act of pronouncing the letter. By this means the pupil feels the expiratory thrill caused by the articulation of the letter, and will further note that the tongue lies flatly upon the floor of the oral cavity, and that the mouth is open. The child will have very little difficulty in pronouncing the letter: it may occasionally be necessary to depress his tongue once or twice. The pupil is then caused to place his hand upon his own chest, and repeats the letter. By feeling the vibration, he becomes conscious of the fact that he has accomplished the feat. The letters *o* and *u* are pronounced with visible modifications of the position of the lips.

In *m* the lips are slightly closed, and the air passes in a vibration through the nose. By placing the forefinger of the pupil against the nostril, he will feel the letter as it is pronounced. After a few attempts, he will readily succeed in enunciating the letter himself. In *f* the tip of the tongue rests against the upper part of the lower gum; the upper teeth rest lightly upon the lower lip; and the lips are lightly closed excepting at the centre, where a small opening is preserved, through which the air hisses. If the pupil holds the back of the hand a little distance from the mouth, he will feel the letter as it is pronounced. He will easily learn to pronounce the letter after one or two endeavors. By holding his hand before his own mouth, he perceives whether he pronounces the letter correctly or not. In *v* the upper teeth rest lightly against the lower lip, and the air passes through them. By holding the back of his hand under the chin, the pupil will again feel the letter pronounced. In *s* the tip of the tongue rests against the upper gum, the teeth are closed, and the air hisses through them. The pupil will learn to pronounce the letter at the first attempt.

Now, some may consider this to be a very slow process, which exhausts the patience of both teacher and child; but let me say, as one familiar with the subject, that this is not the case. With a little experience on the part of the teacher, a class of ten or twelve congenital mutes of ordinary intelligence will acquire the entire alphabet within ten or twelve weeks, and will be able to read from the lips, and speak and write such monosyllabic words as "book," "fan," "hand," "mouth," "cap," "fish," "hat," "house," "cup," "man," etc. At the expiration of the first year they will be able to make use of simple sentences. Even though the voice of some congenital mutes may not be as pleasant as that of others, the labor expended is not lost; for such have the advantage, first, of being able to read from the lips whatever is spoken; and, second, the value of the impression which has been made upon the mind by articulating the word. I need scarcely say that all this is more readily acquired by semi-mutes, and that their voices sound more pleasantly to the ear. We should, moreover, consider the injustice which has been and is now practised against the semi-mutes, and they constitute a large percentage. By those schools which make use of the sign-language, they are classed with congenital mutes, who employ only signs in communicating with one another, and naturally the former do not find opportunity for retaining what speech they may have possessed. Sometimes even the teacher is a mute. Under these circumstances, and as if designedly, the semi-mute is bound to forget speech, especially after he has acquired the sign-language; and finally he becomes so imbued with muteness, that he actually becomes ashamed to use his voice. I have had the opportunity of observing the effect produced upon semi-mutes, when brought to an institution where signs were used. For a while they could not recover from their bewilderment and confusion when they,

[1] See my article on "Deaf-Mutism: its Pathology, Causes, and Treatment,' in the New York Medical Record, Nov. 3, 1888.

viewed their surroundings, and noted the inmates making faces, throwing their hands and arms up and down, forwards and sideways, and they themselves utterly oblivious to the meaning of these pantomimes. The effect is as if a sane man were suddenly put amidst a crowd of lunatics. Several highly educated teachers, who were connected with a school for deaf-mutes where signs were used, acknowledged to me the fact that there has never been a congenital deaf-mute educated in this country by the sign-language who could use the English language correctly. All those who are paraded at exhibitions are semi-mutes, who had a fair knowledge of language when they were brought to school. If those advocates of the sign-language who claim that a succession of gifted and philosophic men have improved the methods of educating deaf-mutes would only have retained and cultivated the speech of the semi-mutes intrusted to their care, they would have merited claim for earnestness and sincerity of purpose; but these are, and always have been, the very ones to fiercely combat every honest attempt to improve the mental condition of this unfortunate class. A very able opponent of the sign-language very truly said, "Different views may be harmonized, but different motives never." The sign-language obtained a foothold in this country merely through accident. Its exponents have sprung from one family here, who are so deeply indoctrinated with the fallacious cult, that self-interest and obstinacy prompt them to make a combined stand against reform. Nevertheless, since the Institution for the Improved Instruction of Deaf-Mutes in this city, and the Clark Institution at Northampton, Mass., came into existence (now a matter af over twenty years), where all the branches of an education are imparted in articulated speech with success, the sign-language began to decline. It is true, it dies hard; but the sooner this end is obtained, the better it will be for all concerned. Rest to its ashes!

In the "Reference Handbook of the Medical Sciences," Professor E. M. Gallaudet, Ph.D., LL.D., contributed an article on the language of signs and the combined systems of instructing the deaf-mutes. The greater part of the article is devoted to demonstrating the fact that such a thing as a sign-language really exists, and contains historical notes and narratives, evidently cited with a view to proving its origin and varying fortunes. Remarkable! The learned professor might be surprised to find, on consulting any competent lexicon, that there exists, besides, a language expressed with the eyes, one with flowers, one by means of music. The click of the telegraph-instrument is a most useful mode of communication. Thieves use a language expressed with the fingers, eyes, and feet, etc. All of them have been and are made use of by hearing people with more or less utility and practicability. But articulate speech is pre-eminently the language of the human race, alike for the hearing and the deaf. The various substitutes which human ingenuity has invented are the outcome of peculiar circumstances. The hearing child makes use of gestures before it acquires speech, as a matter of necessity; the intelligence of the child determines the expressive value of the gesture; and the same is true of the deaf-mutes. In summing up the advantages of the combined system, the writer says,—

"The experience of nearly a century and a half of practical instruction of the deaf has established no conclusion more clearly than that it is impossible to teach all deaf-mutes to speak. Some are found to be lacking more or less in mental capacity; some have only a weak and inefficient imitative faculty; with others an infirmity of vision is discovered; others, again, have little quickness of tactile perception."

It may have taken some specially constituted instructors to come to such a conclusion; it may be said with equal justice that "a century and a half of experience" has proven conclusively that it is impossible to teach all hearing children to speak or to write correctly or intelligently. Any intelligent layman knows that a lame child may also be near-sighted, and that one thus afflicted will make neither a good foot-racer nor an expert hunter. All hearing people are surely not on the same plane of intellectual, physical, and moral vigor; for, if they were, such inadequate means of instructing the deaf as the sign-language would never have found favor.

"In former times these doubly or trebly defective children were summarily dismissed from oral schools with the unjust and inhuman condemnation that they were imbeciles; and even at the present they are quietly dropped from such schools under one pretext or another, because the oral teachers are perfectly well aware that they cannot be educated under their method."

Even the intelligent congenital mute cannot get a fair education at a school where the sign-language is used as the basis of instruction, much less the feeble-minded ones. I admit, those feeble-minded ones are retained at those schools at three hundred dollars a year, as a matter of pecuniary interest only.

"The essential defect in the oral method is, then, that it practically rejects a large proportion of the deaf as incapable of education; that it fails with those who stand in greatest need of a helping hand."

Mind, that cannot be impressed with the meaning of a word, expressing abstract thought by articulation and by writing, can neither be impressed with the meaning of an artificial sign.

Dr. Gallaudet admits that "the radical deficiency of the manual method is, that it makes no provision for imparting the extremely valuable accomplishments of articulation and lip-reading to the large percentage of the deaf that is certainly capable of acquiring these great gifts." The radical deficiency of the manual method, in better words, is, that it is a failure as a means of instructing congenital mutes, and that it perpetrates a gross injustice upon the semi-mutes, in that it renders them dumb.

"The doors of the combined-system schools are wide open to *all* the deaf,—to the weaker as well as to those more richly endowed with capacity for improvement. In these schools no method or appliance is rejected that can be shown to be of practical help to any number, however small, of the great class of the deaf." If this were true, those schools should have established separate classes or schools for the semi-mutes,—an innovation so far never even attempted.

"He who would assume the responsibility of advising parents as to the most desirable course to be pursued in the education of a deaf child should never forget that to teach such a child to speak comes very far short of educating him." How considerate and unselfish!

"In oral schools there is a strong tendency to lay the stress and emphasis of the work of instruction on speech; and to secure success in this, many matters of greater importance to the pupil are sacrificed, for, in spite of the zealous assurances of promoters of oral teaching that speech is an inestimable boon to the deaf,—the thing of paramount importance,—it remains true that there is not one of the main objects sought to be accomplished in the general education of the deaf which will not be seen, with a very little reflection, to be of more consequence to a deaf child than the mere ability to speak and to read from the lips of others."

If the above is not a wilful misrepresentation, it betrays, certainly, ignorance of the subject under consideration; for, after a class of congenital mutes has mastered the mechanism of articulation which is completed within the first year, instruction goes on as in a school for hearing children.

"To be able to read and write intelligently, to possess the knowledge that is imparted in common-school training, to be master of a trade by means of which one may gain a livelihood, to be well grounded in principles of morality, to enjoy an abiding faith in God and a hope of immortal life,—surely each one of these, weighed over against a mere ability to speak, would be found of far greater value to the deaf."

Congenital mutes who are educated by means of the sign-language can hardly acquire a trade in common with the hearing, for the reason that they cannot express themselves intelligently by writing; and their artificial signs are not understood, and certainly look ridiculous, especially to the illiterate; while those taught by articulation do not meet with these obstacles. To cover the failure of their system of signs, those schools were compelled to open workshops in connection with their schools. The religious training of the pupils in those schools cannot be so thorough where the knowledge of language is so meagre.

"The achievement of imparting speech to one who has it not comes so near to being a miracle that one is dazzled by the brilliancy of the triumph, and is apt to feel that every thing else in

the education of the deaf must be subservient to this. Parents and friends of the deaf need to be placed on their guard against this grave error, and to be advised that those schools and systems best deserve their confidence and support that seek to give the broadest and most valuable education possible to *all* the deaf."

After what has been said, the conclusion which the unbiassed will be forced to is, that the combined system, which consists of the sign-language as the basis of instruction, and, in addition, as a side-show, pretends to teach articulation, is a farce, which serves to mislead parents and friends of the deaf; and that the language of signs, instead of being a stepping-stone, is a hinderance to deaf-mutes in the acquisition and in the use of spoken language.

B. ENGELSMAN.

New York, Oct. 8.

Another Magnetic Man.

MY attention has been called to the following account from a Lewiston paper, dated Sept. 25, of a scientific phenomenon in which your readers may be interested.

"The writer was entertained Friday evening by a wonderful man, a resident of College Street. The gentleman is a well known citizen of most trustworthy character. After an evening's performance he feels exhausted in the morning. He can do nothing with the palms of his hands on the object, but must use the tips of his fingers only. He first began with a common table with swinging sides. Placing his fingers nearly in the centre, he could cause either end to rise and remain suspended. It would rock, beat time to music, or turn a complete somersault. No part of his person touches the object but his finger-tips; and there are no secret wires, for we examined the table carefully. Next he let down the swinging sides, which are on hinges, and, by placing his finger-tips, could raise the leaf, and hold it in that position several minutes while we tried to pull it away from his fingers. Then we took a heavy braided rug, and folded it in four thicknesses, and placed it on the table. With this obstruction he easily lifted the table, and turned it completely over. A plate was put upon the table, and this proved no hinderance. Then a tin dish inverted was given to him, and still the table not only came up, but the tin dish stuck fast to the table. He lifted chairs and other objects while resting. Then the table was inverted; and, placing his finger-tips upon the table-legs, the heavy table came up, and remained clearly suspended from the floor, with one foot of clear space beneath.

"The writer then sat upon the end of the table, which came up so suddenly as to throw him off upon the floor. At last came a strong test. We seated ourselves in chairs at opposite sides of the table, the writer grasped the table-legs with all his strength, and the gentleman stood clear of the table, and, placing only his fingers upon the smooth surface, drew the table so violently as to bring us down upon the floor in confusion.

"Finally we grasped hands and tested our natural strength in pulling, and the writer was the stronger man; but, as the current came down in his arms, it went up into ours, feeling just the same as when we hold the handles of a battery. Then the strength of the gentleman was wonderful, throwing us around the room as one would handle a toy. The whole evening was filled with these performances. There is no possible chance for deception, and those who have seen this say that the only motive power which these objects receive comes directly from the finger-tips of this man. He can perform the same feats in any room, or with any soft-pine table, which may be placed in any position."

E. W. HALL.

Waterville, Me., Oct. 7.

BOOK-REVIEWS.

Erster Nachtrag zur Bibliographie des Modernen Hypnotismus. Von MAX DESSOIR. Berlin, 1890.

IN *Science* of June 22, 1888, will be found a notice of the original work to which the author now issues a supplement. The arrangement of the two contributions are practically the same, the supplement including all that was published from May, 1888, to May, 1890. No more striking proof of the increase of interest in the subject of hypnotism could be furnished than the fact that this record of two years' work includes 382 titles of articles or books, written by 274 authors in 13 different languages, and appearing in 113 periodicals. Very interesting, too, is the variation in interest in different countries that has been going on in the last two years. In the former bibliography the French language was credited with 473 titles; English, with 102 (40 of which were American); Italian, with 88; German, with 69; and the rest scattering. In the supplement France still leads with 139, but Germany (probably in part including Switzerland) is a close second with 103; English comes next with 46 (24 of which are American); Italian following with 32.

The author has evidently done all in his power to render this bibliography useful and complete, and deserves great credit for carrying on this necessarily unpleasant work. He again asks for contributions and notices of works and articles bearing upon hypnotism, to be sent to Röthenerstr. 27 W., Berlin.

Guyot's Earth and Man. Revised edition. New York, Scribner.

THE republication of Guyot's famous lectures on "The Earth and Man" recalls a time which seems, in comparison with the wider opportunities of the present, to be a time of scientific awakening, and which is marked in contrast with this age of conventionalism as a time of scientific enthusiasm. In 1849, when Guyot gave these lectures in French at the Lowell Institute in Boston, the earlier geological surveys of our States were in progress or had but recently been completed. A great fund of fresh scientific information was published by them. Agassiz had come to this country a few years before, and was then about to gather around him the first of the band of students of natural history through whom he so greatly enlightened us. Lyceum lectures then held the place now taken by magazines, and public teachers were orators in the sight of their hearers, not writers hidden behind paper and print. Guyot's book is characteristic of that time. The several chapters retain to perfection the quality of enthusiastic discourses by a man full of his subject and devoted to it. It is doubtless for this charm of style, as well as for the interest of its matter, that the book has so long and deservedly been popular with geographic readers.

Two chief lines of thought run through the book. One is the importance of the vertical element,—the relief of the land; the other is the intimate relation between the conditions of the land and of its inhabitants. Concerning both of these aspects of geography we owe much to Guyot; but the "Earth and Man" hardly represents their present position. The more modern phase of geographic study accepts the importance that Guyot placed on relief, but adds the more direct consideration of local form and its evolution, to which Guyot gave but brief attention. The physical control of human conditions is as attractive a study as when Guyot brought it to us; but, with a fuller understanding of its complexities, we have come to be perhaps more cautious in our generalizations than he was. The modern writer might well hesitate before connecting the great area of our forests and the "melancholy, cold, and insensible" nature of our Indians in the relation of cause and effect.

As a book illustrating a well-marked epoch in our geographical lirerature, Guyot's "Earth and Man" should be placed in every school library; but, as a school-book for this end of the century, it cannot be highly regarded, although its publishers would seem to place it in that light. It does not appear to us to be true, as is claimed in a prefatory note to the book, that "the present edition of 'Earth and Man' has been revised in a few points affected by the progress of scientific knowledge since the appearance of the work." It would not be Guyot's "Earth and Man" if it were so revised. It would be a new book. Moreover, it possesses few of the qualities desired in a modern text-book. It is not demonstrative or disciplinary in its quality, and this because it accomplishes so precisely the intention of its author. It presents his glowing lectures as they were given; and as such, without significant revision, its republication is welcome.

A Digest of English and American Literature. By ALFRED H. WELSH. Chicago, S. C. Griggs & Co. 12°. $1.50.

THE object of this work is to give an epitome of English literature from the earliest Anglo-Saxon period to the present day. The matter is arranged in four columns: the first containing a brief mention of the most important historic events; the second, a review of the characteristics of each age, so far as they affected literature; while the remaining two are devoted to the various authors and their principal works. The space given to each author is necessarily small, rarely extending to a page; but the style is concise and sententious. and usually clear, so that a good deal of information is conveyed in a compact and intelligible form. The work is divided into periods; and on the whole the division is well made, though it seems to us that some of the writers credited to the Puritan period belong, both by style and by subject, to the earlier, or renaissance period. As regards the authors who ought to be noticed in such a work as this, opinions will differ somewhat according to the standpoint and the taste of each reader. Some of those to whom Mr. Welsh has accorded considerable space seem to us unworthy of a place in such a book; while others of greater weight and influence, such as Charles Darwin, John Henry Newman, and E. A. Freeman, are not noticed in the body of the work, and receive but a bare mention in the appendix. Such omissions, however, are mostly confined to the concluding portion of the book, and are perhaps accounted for by the author's unfortunate death, which prevented his giving the final touches to his work. On the whole, this digest is excellent, and will be useful not only to students, for whom it is more particularly designed, but also as a reference-book for general readers.

AMONG THE PUBLISHERS.

THE following are among the new publications announced by the J. B. Lippincott Company, Philadelphia: "European Days and Ways," by Alfred E. Lee; "The Distribution of Wealth," by Rufus Cope, being an examination of the extent and sources of our wealth and its distribution in the different branches of industry and trade, in which the author discusses in a popular manner the various important economical problems now so generally agitated, and by his keen logic adds materially to their solution; "Hermetic Philosophy," including lessons, general discourses, and explications of "Fragments" from the schools of Egypt, Chaldea. Greece, Italy, Scandinavia, etc., designed for students of the Hermetic, Pythagorean, and Platonic sciences and Western occultism, by an acolyte of the "H. B of L.;" "Gleanings for the Curious from the Harvest-Fields of Literature," a melange of excerpta, collated by C. C. Bombaugh; "The Two Lost Centuries of Britain," by William H. Babcock, in which the author gives an account of the period intervening between the evacuation by the Romans and the commencement of authentic history of modern England, having earnestly and critically sought out the truth embodied in the various legends and traditions current concerning that time, and woven them, with the facts derived from various authoritative sources, into a most interesting and reliable narrative, which will prove a valuable addition to historical literature; "The German Soldier in the Wars of the United States" (2d edition), by J. G. Rosengarten, in which the distinguished part borne by German officers in the Revolution and the war of the Rebellion is thoroughly treated by the author, his work showing careful research; "Medical Diagnosis, with Special Reference to Practical Medicine: A Guide to the Knowledge and Discrimination of Disease," by J. M. Da Costa; "A System of Oral Surgery," by James E. Garretson; "Triumphs of Modern Engineering," by Henry Frith, author of "The Opal Mountain," etc., being a record of the latest and most interesting feats of our own and foreign engineers, showing the advances of modern engineering work—railways, bridges, tunnels, engines, docks, canals, etc.—from the popular point of view, compiled from authentic records and notes, as well

as from personal experiences; "The Chemistry of Iron and Steel Making, and of their Practical Uses," by U. Mattieu Williams, being written with the well-defined object of supplying to the producers and distributers of iron and steel, and to engineers, ship builders, architects, and others concerned in the use of these important materials, the special scientific knowledge which they all should possess, and in simple, clear, and readable language, the inevitable technicalities being explained as they occur; "Chambers's Encyclopædia," Vol. VI., an entirely new edition, revised and rewritten,—a dictionary of universal knowledge, edited and published under the auspices of W. & R. Chambers, Edinburgh, and J. B. Lippincott Company, Philadelphia, to be completed in ten volumes, issued at intervals of a few months; "Historic Note-Book," by the Rev. E. Cobham Brewer, LL.D., Trinity College, Cambridge, author of "The Reader's Hand-Book," "Dictionary of Phrase and Fable," etc.; and "Regional Anatomy in its Relation to Medicine and Surgery," by George McClellan, M.D., illustrated from photographs taken by the author, of his own dissections, expressly designed and prepared for this work, and colored by him after nature.

—Campanini, the famous tenor, has written a striking article on "How to Train the Voice" for *The Ladies' Home Journal,* and it will appear in the November number of that periodical.

—"The Economics of Prohibition," by James C. Fernald, is a work just issued from the press of Funk & Wagnalls. It is an attempt to show the costliness of dram-drinking, and the efficacy of prohibition as a preventive. The first part of this task is an easy one, and is successfully accomplished; but the argument for prohibition is less successful, and contains nothing new. Mr. Fernald endeavors to show that high license has proved useless as a promoter of temperance; but the facts he adduces on this point are too meagre to be conclusive. He makes a good point against local option on the ground that it makes an act criminal in one part of the State that is not so in another; but on the whole he leaves the question pretty much as he found it. The style of the book is of that extravagant and excited character that we are accustomed to find in the works of prohibitionists. Why is it that temperance men are usually so intemperate in their language, and when will they learn that soberness and dignity are more persuasive than rant?

—The Colorado College Scientific Society, Colorado Springs, Col., has issued the first number of a yearly volume, to be known as "Colorado College Studies," which shows that there is some activity in this new educational centre. The table of contents is as follows: "Announcement;" "A Rigorous Elementary Proof of the Binomial Theorem," by F. H. Loud; "On Certain Cubic Curves," by F. H. Loud; "A Study of the Inductive Theories of Bacon, Whewell, and Mill," by Benjamin Ives Gilman; "A Mathematical Text-Book of the Last Century," by F. Cajori; "Horace, Od. III. 1, 34," by George L. Hendrickson; "Quinti Ciceronis Commentariorum Petitionis XI., § 43 (B. et K. vol. ix. p. 487)," by George L. Hendrickson.

—Herbert Spencer will contribute the opening article for the November number of *The Popular Science Monthly.* It is on "The Origin of Music," and extends the discussion in his essay on "The Origin and Function of Music," opposing Darwin's view that all music is developed from amatory sounds. A criticism by

the late Mr. Gurney is also replied to in this article. The address of Professor T. C. Mendenhall, as president of the American Association for the Advancement of Science, will be published in the same number. Its subject is "The Relations of Men of Science to the General Public," and it tells scientific men a number of ways in which they can make themselves more useful and better appreciated. There is also an account of the root-tip of a plant, the way it grows, the work it does, and its behavior when subjected to unnatural conditions, by Frederick L. Sargent. "School Life in Relation to Growth and Health" is the title of a paper by Professor Axel Key of Stockholm. Professor Key maintains that the studies of children, as now ordered, do not allow enough time for rest and growth, and urges a reform in this respect. "The Logic of Free Trade and Protection" will be discussed by Arthur Kitson. Mr. Kitson takes Mr. Blaine as an authoritative exponent of protection, and subjects the doctrine as stated by him to a severe criticism, on the ground of not being a logical outcome of existing facts.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—To purchase a complete set, or single numbers, of Loomis' contributions to meteorology, published in the *American Journal of Science*. Address communication, stating price, to FRANK WALDO, Mountain Lake Park, Garrett Co., Maryland.

COULD some one inform me what the ingredients and origin of asphalt as used for street-paving and gathered at Trinidad are? Also how gathered and shipped by natives, and mode of refining by the Warren-Scharf Co. of New York and the Barber Co. of Washington? G. KNIPER, 28 Gunn Block, Grand Rapids, Mich.

WANTED.—A position in a Normal School or College as teacher of Botany, Physiology, Zoology, Embryology, Chemistry, Physics, or German, by a university graduate who has done special work in the above lines. Several years' experience in teaching, and one year as assistant in Biology in a prominent university. Box 396, Greencastle, Ind.

PROFESSOR W. M. DAVIS, Harvard College, Cambridge, Mass., desires to correspond with professional and amateur photographers, from whom he can obtain views of New England landscapes.

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THE CIVILIAN ELECTRICIAN IN A MODERN WAR.[1]

I BEG to propose for your consideration this evening a plan by which, in time of war, all the electrical resources of New York, both in supplies and in men, will become at once available for the defence of the country and the city.

It is well known to all here that electricity has come into use as one of the great factors in warfare, both on sea and on shore; not as an adjunct merely, as for lighting ships and forts, but as a vital element in the handling of weapons in actual battle, and in the construction of new instruments which accomplish things heretofore impossible.

I desire to recall to your recollection a few of the most important uses to which electricity is now put in warfare, to indicate some of the probable paths of future development, to show that it would be impossible for our navy and army to adequately handle the vast electrical work that would have to be instantly done in time of sudden war, and to suggest a plan for coming to their assistance.

The science of electrical engineering is now recognized as one of the most necessary of the practical sciences of the world. It stands out as distinct and well defined as the science of medicine or the science of astronomy. It enters into thousands of the departments of daily life, but in no other department is it used in so various and so important ways as in warfare. This is so much the case that the prophecy is sometimes ventured that in the near future nations will fight by electricity. Though this, like all extreme statements, requires modification, yet the number of ways in which electricity has come to be applied within the last eight years, is calculated to inspire the liveliest anticipations as to the developments of the next eight years. No vessel pretending to modern equipment goes to sea without a complete electric plant for furnishing light. This light is so much more suited to ship life than any other light, that we now wonder how we ever went to sea without it. The electric motor is coming into use for ventilating ships, and it is beginning to be used for training guns and the hoisting to the deck of shot and shell. The best and the most accurate results at target practice are attained when the guns are fired by electricity. Range finders give the gunner constant knowledge of what he must know; i.e., the distance of the enemy. The best means of night signalling, and the one adopted in nearly every navy in the world, is by means of incandescent lights. The electric search-light is almost as much a feature of the equipment of a modern war-ship as are her guns and her torpedoes. In the actual use of the Whitehead and the Howell torpedoes, electricity plays an important part. The telephone is now coming into use for ship-work, and will unquestionably supplant the speaking-tube, which is acknowledged in all navies to be unsatisfactory. In fact, we find all through modern war-ships an increasing use of electricity. The reason is clear. The modern war-ship is the most intricate, tremendous, and powerful machine existing. In no other equal space can be found so many, so various, and so important kinds of apparatus. Every thing must be done which will put her absolutely within the grasp of the captain. She must respond at once to his command, and her whole strength and power must be his, as though she were a part of him. Ensconced in his armored conning-tower, he must be the brain of the gigantic body. Electric wires must convey instant tidings to him from her innermost recesses, and electric wires flash back from him the inevitable command. In this way only can a modern ship, no matter how large, how strong, how heavily armored, or how swift, completely fulfil her mission and be a perfect fighting-machine.

What is true of ships is equally true of forts. The power of ships' guns has so increased that it has become essential to protect shore batteries by iron and steel instead of masonry as in the days not long gone by, and, in addition, to use disappearing carriages wherever it can be done. Disappearing carriages, as is well known, are so arranged that the gun disappears below the parapet of the fort when the gun is fired, and remains out of sight and safe during the operation of loading, so that it is exposed only for a short time when it is raised to fire. Now, without the aid of electricity, a very considerable time would elapse, even after the gun was raised, before it could be fired; because the gun would have to be trained in the proper direction, and be elevated to the proper degree, for propelling its projectile over the distance between it and the enemy. To estimate this distance and make the proper adjustments would entail delay, and would be absolutely impossible if smoke obscured the target, as would be the case during a great portion of the time. But electricity, acting through the medium of the position finder, gives the gunners continuous information of the distance and direction of the enemy, no matter how thick the smoke; so that the gunners know exactly what to do, before the gun is raised to fire.

Electricity, furthermore, gives the commanding officer complete control of all the different groups of guns and mortars in his fort. Noting the progress of the action from a station aloof from the smoke and noise, he can direct the concentration of as many batteries as he thinks best on one ship, or can disperse the fire as much as circumstances from time to time dictate.

For the handling of the monster apparatus used in forts,—the guns, the carriages, the ammunition,—electricity is rapidly coming to the front. Some power must be used, since the muscles of men are too weak. Hydraulic power has been used hitherto, but for many purposes electricity has the same advantages that have caused its unprecedented advance in the other departments of engineering throughout the world; while for repelling a night attack from ships the search-light has been found, by repeated trials in the naval manœuvres abroad, to be simply indispensable to the land defence. For military service in the field there is not an army in the civilized world that has not its military telegraph service. One great cause of the suddenness and completeness of the German victory in 1870 was the rapid mobilization of the Prussian Army, and its appearance on the frontier ready for battle. Now, the splendid efficiency of the telegraph service in the hands of the military authorities made this possible. Nothing is more important in warfare than despatch in moving the enormous bodies of men of which modern armies are composed, with all their ammunition, equipments, and numberless accessories. To move a quarter of a million of men to the frontier in one day means a good deal; and to manœuvre so large a body in the field with such precision and rapidity that no one division shall have to wait for any other division, simply cannot be done without electricity.

But the most immediate and important use of electricity in the

[1] Paper read before the New York Electrical Society at Columbia College on Oct. 23, by Lieut. Bradley A. Fiske, U.S.N.

defence of a coast is in the submarine mine or ground torpedo. Defending a harbor with submarine mines is simply carrying out with more or less elaboration a system by which a large number of water-tight tanks, each holding from 100 to 1,000 pounds of gun-cotton or other explosive, are anchored in carefully designed positions, and connected by armored electric cables with protected operating-rooms, in which are batteries, measuring-instruments, etc. The most complete mines have usually floating above them automatic circuit-closers, in which two contact points are jarred together by a passing ship, and thus afford a passage for the electric current to the fuze in the torpedo. Now, these mines are some of them exceedingly large and heavy, and the electrical apparatus, while simple to the mind of a trained electrician, yet must be made and adjusted with great care. The torpedoes, as a system, must be constructed, laid down, and connected to the operating rooms on shore by long and heavy armored cables. The operation of practically planting and connecting the necessary submarine mines for New York would be a stupendous undertaking. Kindly bear this in mind until I recur to it again.

We have now seen, after a rough survey of the subject, that electricity has already acquired an acknowledged position in the art of war, and that the uses to which it is put are not trivial ones. Electricity is not used in warfare as a convenience, nor is it a fad of theorists: it fires the guns, it discloses the stealthy approach of the torpedo-boat at night, it directs the proper elevation of the guns,—in fact, it does good, honest, practical work. But note this point also: in every one of these applications of electricity we have to pay in one way, for what we get, by studying the ways in which electricity will work for us. We cannot expect electricity to work for us unless we treat it properly. We cannot handle electrical apparatus with carelessness and ignorance, and expect that it will work when we need it. In other words, we find in warfare, as in every thing else to which electricity is applied, that electricians are useful. This remark doubtless seems absurdly commonplace, but it is intended to suggest that, in war time, electricians, even civilian electricians, may suddenly become very useful to the government. A captain of a fine ship might lose an action from simply a lack of knowledge as to some electrical appliance, on his own part or on the part of some subordinate. Some small accident might break a circuit just at a critical juncture, which might prevent the communication of an order, the receiving of information, or the discharge of a torpedo, at a crisis; and yet the cause might be such that a man with even a very slight knowledge could remedy the difficulty in a second by the mere pressure of his finger; but, that pressure not being given, the action might be lost, and from that cause alone.

Let us now glance at some of the other uses to which electricity would probably be put in case of an attack upon New York. There can be no reasonable doubt that Lay torpedoes, Patrick torpedoes, Sims-Edison torpedoes, and Halpine-Savage torpedoes would come to the front at once. The enemy's fleet being daily expected off Sandy Hook, we should see the advocates of these systems, under authority of the general government, preparing stations at Coney Island, Sandy Hook, and elsewhere, for the launching of their dreadful missiles against his iron-clads. The question of ballooning, both for observation and for the dropping of explosives on his decks, would be taken up at once, and the electrical world would be agitated anew over the question of balloon propulsion by electricity. Electric launches to carry torpedoes would be fitted out to noiselessly steal out at night on their errands of destruction. Electric picket boats, of smaller size, perhaps, would scout the waters in pursuit of information or to convey despatches; electric submarine boats would spring into being by the dozen, and, filled with adventurous spirits, would seek the enemy, secure from detection below the surface of the sea, and carrying enough explosive to utterly destroy the proudest war-ship of the world.

It will now be apparent, that, in the case of a sudden war,—and most wars are sudden,—there will be an immense amount of work to be done in the electrical line alone. Could our army and navy do all this work in the time allowed? It is probably known to all here that our regular army and navy are simply a nucleus around which fighting forces could be formed. They are so small, as regards both officers and men, that they can barely carry on the work in time of peace, and would be wholly inadequate in time of war. We should not have enough battle-ships, monitors, cruisers, or torpedo-boats; we should not have enough forts; we should not have enough sailors; we should not have enough infantry; we should not have enough artillery; we should not have enough electricians. Take the single matter of laying out and connecting up the submarine mines in New York harbor. This is an area covering many square miles, in parts of which the mines would be placed at frequent intervals, every mine being accurately secured in its designated place, and connected by cable to the operating room, perhaps miles away. The mere labor of constructing, fitting, and filling one mine, and afterwards taking it out into the harbor and lowering it into place, with all its connections, is no small task; and what can be said of the task of doing this with hundreds of submarine mines? Then the work of properly arranging the various cable connections, testing apparatus, firing apparatus, etc., necessary for the efficient action of the mines, would follow. The Board on Ordnance and Fortification have designed all the torpedo defences, but they will not be in practical operation probably for many years, and a war may come meanwhile. But it is certain that on the outbreak of any war an immense amount of this work would have to be immediately done, because we will never keep the submarine defences of New York harbor on a war footing in time of peace.

The Navy Department would be even more hurried. We should certainly be called upon to commission a great many war-ships, and to equip as commerce destroyers a great many merchant steamships. We should have to do all the things that we did on the outbreak of our last war, and in addition we should be confronted with the necessity of fitting all kinds of fine apparatus, the necessity of fitting electrical appliances of all descriptions, besides securing gun-circles in place with mathematical precision, and of accomplishing all the manifold fine work that is required with the ordnance, navigation, and engineering equipment of a war-ship of the present day. And as to merchant ships, who is going to fit them out? This operation requires technical knowledge. Who has it? How many of the merchant steamship captains would be able to install and manage a battery of even Hotchkiss or Driggs Schroeder guns, or could remedy an accident to either gun or ammunition?

It being apparent that the regular army and navy, in event of a sudden war, would be unable to handle all electrical work that would certainly be thrown upon them, I propose the formation of a corps of naval and military electricians to assist the army and navy in their work. Such a corps might exist in every principal seaport town on the coast; the principal corps, of course, being the one with headquarters in New York. Electricity being now a recognized factor in both naval and military war, and requiring expert electricians for its full development, there would seem to be just as much reason for an electrical corps in the National Guard of the State of New York as for infantry, artillery, or cavalry. While the members of this corps would be men of technical knowledge, and while its sphere of usefulness in war would be because of that technical knowledge, it is obvious that the organization should be a military one, and that, with some modifications, it should be governed by the same principles as govern all military bodies. Being a military body under the governor of the State, it could at once become available on the outbreak of war.

It would seem that this corps, like all other corps, should be composed of men of various ranks, subject to various duties. Many kinds of work would have to be done in war, and many kinds of men would be required to do them. On the outbreak of war, certain members would naturally elect duty in the navy, others in the army. The most obvious and immediate employment would doubtless be in the torpedo defence of the harbor, under the direction of the general commanding. And who can doubt the gratification which that general would feel, when suddenly ordered to defend New York harbor, on finding ordered to his list of subordinates a hundred or more capable electrical engineers, young, enterprising, accustomed to difficult electrical work, fully acquainted not only with electricity in its technical

features, but also acquainted with the electrical people of New York, with its factories, its places of business, and its methods of business? These men would become available in a day, and could be at once set to work in carrying out the details of a vast and complicated system. Their work need not be confined to that purely electrical in character, because every electrical engineer is by training and of necessity a mechanician, and every sort of apparatus would be readily understood by him, and a very slight training would make him master of it.

Those members volunteering for naval work would be equally useful. The ordnance officer at the Navy Yard would constantly find himself overwhelmed with a mass of work which he would be utterly unable to carry out without the assistance of some such corps as this. And for the reason that electrical engineers are of necessity mechanicians, a great deal of technical work could be intrusted to them, such as the arrangement and fitting of gun-carriages, the storage of ammunition, the assembling of guns, etc. Their more immediate and obvious field, however, would be in the installation and fitting of electric lights, motors, telegraphs, telephones, and other electrical appliances, on board the vessels of war constantly called into requisition. In the matter of fitting out merchant steamships their usefulness would be at once apparent. The number of regular officers would be found utterly out of proportion to the number of ships, and the whole navy would undergo an expansion. Only a very few regular officers could be assigned to each vessel; so that the majority of the officers would have to be volunteers, as was the case in our civil war. During the first part of the war, the command of the different vessels would naturally be intrusted to regular officers, leaving the other positions to be filled by volunteers. Now, as the commander of a ship is head of all the departments of a ship, he cannot give much personal attention to one especial department. Therefore the general arrangement and fitting-out of all vessels, both regular war-ships and merchant steamships, would have to be largely intrusted to volunteers in all that relates to the electric and ordnance equipments. Now, as the work of fitting out ships with electric and ordnance equipments calls for technical knowledge and experience of a high character, it is obvious that a corps of well-trained technical men, such as is here suggested, would be more than useful: it would be necessary.

A further field for the employment of such a corps in time of war is suggested by the fact that the genius of our people tends towards constant invention and improvement of all sorts of machinery and apparatus; and our history has shown that every war has brought into being many inventions in weapons of defence and offence. Can it be doubted, then, that any future war would produce more such inventions? And in view of the great progress of electrical science since the last war, and considering the great number of electricians in New York, can it be doubted that many of these inventions would be electrical in character? Under the stimulus of a national peril, and with the resources of New York at command, it is certain that important and novel warlike applications of electricity would at once spring into being. And while our regular forces of both army and navy were employed on their specific duties, what more natural than that some new Ericsson should arise, and some new Monitor or other craft startle the nations of the world? Therefore, besides the obvious uses to which such a corps as this might be placed, there are other uses, no less important, of inventing, constructing, and using weapons of defence, the nature of which we cannot as yet even faintly conceive. And as few heroes of our late war go down to history with more glory than has Ericsson, so perhaps our next war may produce some electrician, now unknown, whose fame will outlive the ages.

It would seem as if such a corps as this could be formed under existing laws, and that there would be no difficulty in enlisting members. The attractions of the Naval Reserve and of the National Guard seem sufficient to induce a large membership in the different regiments; and there is no reason why membership in an electric regiment should not be equally desirable and confer equal distinction. The qualifications for entrance as regards education and intelligence would be greater than those for any other regiment or battalion. Its military and naval usefulness would be acknowledged, and its position in all respects would be one of dignity. The larger the membership, the better; provided, of course, that due care be observed in excluding undesirable persons. The whole electrical influence of New York and of the country would be at its back, with all its millions of dollars, and its men of world-wide fame; and there is no reason why it should not acquire a national influence.

The course of instruction could be readily carried out, embracing the naval and military applications of the purely technical science with which the members are already familiar, instruction being given by regular navy and army officers detailed for the purpose. This instruction would naturally embrace the construction and care of apparatus. It being presupposed that there are different ranks in this corps, the system of instruction will naturally differ with the different ranks. With the higher ranks, it would naturally embrace the theory and practice of gunnery, navigation, including compasses, and seamanship. Steam-engineering would probably not need to be taught, it being assumed that the members require very little instruction in that branch. For the lower ranks, the scheme of instruction need not include much more than the handling and care of the different apparatus. On the outbreak of war, the members volunteering for the different services could be subjected to certain examinations, and their rank determined by the proficiency exhibited. As to the details of organization, uniform, etc., these need not be entered into here, as they can obviously be settled at any future time. My only purpose now is to propose to you a plan for meeting an emergency which may some day arise.

I would hazard the suggestion that this corps should at first comprise about two hundred and fifty members, and that it should be officered, uniformed, and drilled as are the other corps of the National Guard. I would even advocate infantry drill as a means of instilling thoroughly the military idea. Occasional runs in the torpedo-boat "Cushing," and frequent trips out to sea for target practice in some of the modern war-ships, would be essential; and while there would be considerable work, there would also be many compensating social and other advantages.

I venture all these suggestions with much diffidence, but earnestly hope that you will think them worthy of earnest consideration. My only excuse for broaching the general plan is that it has been in my mind for some years, that it has been commended by every man to whom I have spoken about it, and that I have been urged to bring it to the attention of the electricians of New York.

THE RELATIONS OF MEN OF SCIENCE TO THE GENERAL PUBLIC.[1]

JUST fifty years have passed since a small body of enthusiastic students of geology and natural history organized themselves into an association which was, for the first time in the history of this country, not local in its membership or in its purpose. As the Association of American Geologists and Naturalists, it was intended to include any and all persons, from any and all parts of the country, who were actively engaged in the promotion of natural-history studies, and who were willing to re-enforce and strengthen each other by this union. So gratifying was the success of this undertaking, that, after a few years of increasing prosperity under its first name, the association wisely determined to widen the field of its operations by resolving itself into the American Association for the Advancement of Science, thus assuming to be in title what it had really been in fact from the beginning of its existence. One of the articles of its first constitution, adopted at its first meeting, provided that it should be the duty of its president to present an address at a general session following that over which he presided. The

[1] Address delivered at the Indianapolis meeting of the American Association, August, 1890, by its retiring president, Professor T. C. Mendenhall.

performance of this duty cannot, therefore, be easily avoided by one who has been honored by his fellow-members in being called upon to preside over the deliberations of this association; nor can it be lightly disposed of, when one realizes the importance of the occasion, and recalls the long list of his distinguished predecessors, each of whom in his turn has brought to this hour at least a small measure of the work of a lifetime devoted to the interests of science.

The occasion is one which offers an opportunity and imposes an obligation. The opportunity is in many ways unique, and the obligation is correspondingly great. In the delivery of this address, the retiring president usually finds himself in the presence of a goodly number of intelligent people, representatives of the general public, who, knowing something of the results of scientific investigation, have little idea of its methods, and whose interest in our proceedings, while entirely cordial and friendly, is often born of curiosity rather than a full appreciation of their value and importance. Mingled with them are the members and fellows of the association, who have come to the annual gathering laden with the products of many fields which they have industriously cultivated during the year, each ready to submit his contribution to the inspection and criticism of his comrades, and all hoping to add in some degree to the sum-total of human knowledge.

The united presence of these two classes intensifies the interest which naturally attaches to an occasion like this, and not unnaturally suggests that a brief consideration of the relations which do exist, and which should exist, between them may afford a profitable occupation for us this evening.

In the beginning it may be truthfully affirmed that no other single agency has done as much to establish these relations on a proper basis as the American Association for the Advancement of Science. In the first article of its constitution the objects of the association are defined as follows: "By periodical and migratory meetings, to promote intercourse between those who are cultivating science in different parts of the United States, to give a stronger and more general impulse and a more systematic direction to scientific research in our country, and to procure for the labors of scientific men increased facilities and a wider usefulness." So perfectly do these words embody the spirit of the association, that, when more than thirty years later the constitution was thoroughly revised, none better could be found to give it expression. That it has been successful in promoting intercourse between those who are cultivating science in different parts of the United States, may be proved by the testimony of thousands who have come to know each other through attendance at its meetings. In a country whose geographical limits are so extensive as ours, and whose scientific men are so widely scattered, it is difficult to overestimate its value in this particular.

In giving a stronger and more general impulse and a more systematic direction to scientific research in our country, it has been singularly fortunate. Its meetings have been the means of disseminating proper methods of investigation and study throughout the land. Hundreds of young students, enthusiastic but often not well trained, have found themselves welcome (sometimes to their own astonishment), and by its influence and encouragement have been moulded and guided in the utilization of their endowments, occasionally exceptional, to the end that they have finally won a fame and renown which must always be treasured by the association as among its richest possessions. Wherever its migratory meetings have been held, the pulse of intelligence has been quickened, local institutions have been encouraged and strengthened, or created where they did not before exist, and men of science have been brought into closer relations with an intelligent public.

But it is in relation to the last of the three great objects to accomplish which the association was organized,—namely, "to procure for the labors of scientific men increased facilities and a wider usefulness,"—that it has been, on the whole, less successful. It is true that when we look at the history of science in America during the past fifty years; when we see at every point evidences of public appreciation, or at least appropriation of scientific discovery; and, most of all, when we observe the enlargement of older institutions of learning to make room for instruction in science, and the generous donations to found new technical and scientific schools, together with an occasional endowment of research, pure and simple,—in view of all these, I say, we are almost constrained to believe that scientific men have only to ask, that their facilities may be increased, and that their labors could hardly have a wider usefulness.

Unfortunately this pleasing picture is not a true reflection of the actual condition of things. The attentive observer cannot fail to discover that the relation between men of science and the general public is not what it should be in the best interests of either or both. In assemblages of the former it is common to hear complaints of a lack of appreciation and proper support on the part of the latter, from whom, in turn, occasionally comes an expression of indifference, now and then tinctured with contempt for men who devote their lives and energies to study and research, the results of which cannot always be readily converted into real estate or other forms of taxable property. It cannot be denied that the man of science is at some disadvantage as compared with his neighbor, the successful lawyer or physician, when it comes to that distribution of confidence with responsibility which usually exists in any well-ordered community, although the latter may possess but a fraction of the intellectual power and sound judgment which he can command. To his credit it may be said that he is usually considered to be a harmless creature, and to render him assistance and encouragement is generally regarded as a virtue. The fact of his knowing much about things which do not greatly concern the general public is accepted as proof that he knows little of matters which seriously affect the public welfare.

It is true that when the public is driven to extremities it sometimes voluntarily calls upon the man of science, and in this emergency it is often unpleasantly confronted with the fact that it does not know where to find him. The scientific dilettante, or, worse, the charlatan, is often much nearer the public than the genuine man of science; and the inability to discriminate sometimes results in disaster in which both science and the public suffer.

In venturing to suggest some possible remedies for this condition of things, it will be logical, if not important, to roughly define the two classes under consideration,—the

scientific and the non-scientific. One is the great majority, the general public, including in the United States over sixty millions of people in all conditions, cultured and uncultured, educated and uneducated, but in average intelligence, we are proud to say, superior to the people of any other nation in the world. Out of these it is not easy to sift, by definition, the small minority properly known as men of science. Only a rough approximation may be reached by an examination of the membership of scientific societies.

The American Association for the Advancement of Science includes in its membership about two thousand persons. It is well known, however, that many of these are not actually engaged in scientific pursuits, either professionally or otherwise: indeed, it is one of the important functions of the society to gather into its fold as many of this class as possible. The fellowship of the association is limited, however, by its constitution, to such members as are professionally engaged in science, or have by their labors aided in advancing science. They number about seven hundred, but in this case it is equally well known that the list falls far short of including all Americans who by their labors in science are justly entitled to a place in any roll of scientific men. On the whole, it would not, perhaps, be a gross exaggeration to say that not more than one in fifty thousand of our population could be properly placed upon the list, even with a liberal interpretation of terms.

In this estimate it is not intended, of course, to include that large class of active workers whose energies are devoted to the advancement of applied science. Although their methods are often the result of scientific training, and while the solution of their problems requires much knowledge of science, the real advancement of science at their hands is rather incidental than otherwise. In certain particulars they may be likened to the class known as "middle-men" in commercial transactions,—the connecting link between producer and consumer. It is in no way to their discredit that they usually excel both of these in vigilance and circumspection and in their quick perception of utility. By them the discoveries of science are prepared for and placed upon the market, and it is difficult to overestimate their usefulness in this capacity. It is true that the lion's share of the profit in the transaction is generally theirs, and that they are often negligent in the matter of giving the philosopher the credit to which he is entitled; but for the latter, at least, it is believed that the philosopher is himself often responsible.

If this statement of the relative numbers of the scientific and the non-scientific is reasonably correct, the scientific man may at least congratulate himself on wielding an influence in affairs vastly greater than the census alone would justify; and this fact encourages the belief, that, if there is any thing "out of joint" in his relations with the general public, the remedy is in his own hands. Let our first inquiry be, then, in what particulars does he fail in the full discharge of his duties as a man of science, and especially as an exponent of science among his fellows?

Without attempting to arrange the answers which suggest themselves in logical order, or, indeed, to select those of the first importance, I submit, to begin with, his inability or unwillingness, common but by no means universal, to present the results of his labors in a form intelligible to intelligent people. When inability, it is a misfortune, often the outgrowth, however, of negligence or indifference; when unwillingness, it becomes at least an offence, and one not indicative of the true scientific spirit. Unfortunately we are not yet entirely out of the shadow of the middle ages, when learning was a mystery to all except a select few, or of the centuries a little later, when a scientific treatise must be entombed in a dead language or a scientific discovery embalmed in a cipher.

Many scientific men of excellent reputation are to-day guilty of the crime of unnecessary and often premeditated and deliberately planned mystification: in fact, almost by common consent, this fault is overlooked in men of distinguished ability, if, indeed, it does not add a lustre to the brilliancy of their attainments. It is usually regarded as a high compliment to say of A, that, when he read his paper in the mathematical section, no one present was able to understand what it was about; or of B and his book, that there are only three men in the world who can read it. We greatly though silently admire A and B; while C, the unknown, who has not yet won a reputation, and who ventures to discuss something which we do understand (after his clear and logical presentation of the subject), must go content with the patronizing admonition that there is really nothing new about this, and that, if he will consult the pages of a certain journal of a few years ago, he will find the same idea,—not developed, it is true, but hinted at, and put aside for future consideration,—or that he will find that Newton or Darwin declared what is essentially the same principle many years before. No one can deny that there is great reason and good judgment displayed in all this, but the ordinary layman is likely to inquire whether it is distributed and apportioned with nice discrimination; and it is the standpoint of the layman which we are occupying at the present moment.

All will admit that there are many men whose power in original thinking and profound research is far greater than their facility of expression, just as, on the other hand, there are many more men whose linguistic fluency is unembarrassed by intellectual activity; and representatives of both classes may be found among those usually counted as men of science. It is with the first only that we are concerned at the present moment, and it is sufficient to remark that their fault is relatively unimportant and easily overlooked. Among them is often found that highly prized but imperfectly defined individual known as the "genius," for whose existence we are always thankful, even though his interpretation is difficult and laborious.

Concerning those who, although able, are unwilling to take the trouble to write for their readers or speak for their hearers, a somewhat more extended comment may be desirable. It is always difficult to make a just analysis of motives, but there can be little doubt that some of these are influenced by a desire to imitate the rare genius whose intellectual advances are so rapid and so powerful as to forbid all efforts to secure a clear and simple presentation of results. The king is lame, and the courtier must limp. With others there is a strange and unwholesome prejudice against making science intelligible for fear that science may become popular. It is forgotten that clear and accurate thinking is generally accompanied by the power of clear, con-

cise, and accurate expression, and that as a matter of fact the two are almost inseparable. The apparent success before the people of the dilettante and the charlatan, has resulted, in the case of many good and able men, in a positive aversion to popular approval. It should never be forgotten that the judgment and taste of the public in matters relating to science are just as susceptible of cultivation as in music and the fine arts, and that scientific men owe it to themselves to see that opportunity for this culture is not withheld. A just appreciation by the people of real merit in art has resulted in the production of great painters, sculptors, musicians, and composers, and there is every reason to believe that the best interests of science would be fostered by similar treatment. Even the great masters in science, then, can well afford to do what is in their power to popularize their work and that of their colleagues, so that, through closer relations with a more appreciative public, their opportunities may be enlarged and their numbers increased.

Another error into which the man of science is liable to fall is that of assuming superior wisdom as regards subjects outside of his own specialty. It may seem a little hard to accuse him of this, but nevertheless it is a mistake into which he is easily and often unconsciously led. That this is the day of specialization and specialists, every student of science learns at the very threshold of his career; but that one man can be expected to be good authority on not more than one or two subjects, is not so generally understood by the public. It thus frequently happens that the man of science is consulted on all matters of a scientific nature; and he is induced to give opinions on subjects only remotely, if at all, related to that branch of science in which he is justly recognized as an authority. Although going well for a time, these opinions often prove to be erroneous in the end, resulting in a diminution of that confidence which the public is, on the whole, inclined to place in the dictum of science.

Examples of this condition of things are by no means wanting, and they are not confined, as might at first be assumed, to the lower ranks of science. A distinguished botanist is consulted and advises concerning the location of the natural gas field, a mathematician advises a company in which he is a stockholder in regard to the best locality for boring for oil, and a celebrated biologist examines and makes public report upon a much-talked-of invention in which the principles of physics and engineering are alone involved.

In these and many other instances which might be related, the motives of those concerned, at least on one side of the transaction, cannot be questioned, but certainly their judgment is open to criticism; and the outcome of it all is, that the confidence of the people in scientific methods and results is weakened. Fifty years ago or a hundred years ago there was good reason for much of this sort of thing. Specialization was neither as possible nor as necessary as now. The sparseness of the population of the country, the absence of centres of learning and scientific research, the obstacles in the way of easy and rapid communication between different parts of the country,—all these and other circumstances contributed to the possibility of a Franklin, who wrote, and wrote well, upon nearly all subjects of human thought; whose advice was sought and given in matters relating to all departments of science, literature, and art. Combining in an extraordinary degree the power of profound research with a singularly simple and clear style in composition, together with a modesty which is nearly always characteristic of the genuine student of nature, he wisely ventured further than most men would dare to-day, in the range of topics concerning which he spoke with authority.

But at the present time and under existing conditions there is little excuse for unsupported assumption of knowledge by men of science, and, fortunately, the danger of humiliating exposure is correspondingly great. The specialist is everywhere within easy reach, and the expression of opinions concerning things of which one knows but little is equally prejudicial to the interests of science and society.

The scientific man should also be at least reasonably free from egotism in matters relating to his own specialty, and particularly in reference to his own authority and attainments therein. In controversy he has the advantage over most disputants, in that he can usually call to his support an unerring and incontrovertible witness. A well-conducted experiment or an exhaustive investigation, carried out with scrupulous honesty, deservedly carries great weight; but it must not be forgotten that it does not, in a very great degree, depend upon the personality of him who directs the experiment or plans the investigation. One must not confound himself and his work, to the extent of assuming that upon him ought to be bestowed the praise and admiration to which his work is, perhaps, justly entitled. This blunder is analogous to that of the mechanic in whom the first symptom of insanity appeared as a conviction that he was as strong as the engine which he had built, evidence of which he unpleasantly thrust upon any who might deny the truth of his assertion. "By your works shall ye be judged," may be especially affirmed of men of science not only as regards the judgment of the public, but particularly that of their colleagues and fellow-workers. Least of all should title, degree, membership in learned societies, or the possession of medals or other awards of distinction and honor, be paraded unduly, or offered by himself, in evidence of his own fitness. In general, these are honorable rewards, which are justly prized by scientific men; but some of them have been so indiscriminately bestowed, and in some instances falsely assumed, that the general public, not yet properly educated in this direction, does not attach great value to them as an index of real scientific merit. Where real merit actually exists, nothing is usually gained, and much is likely to be lost by boastful announcements of high standing or of accumulated honor. A distinguished man of science, at the end of a controversy into which he had been called as such, complained that he had not been recognized as a fellow of the Royal Society. "You gave us no reason to suspect your membership," quietly but severely replied a man of the world.

As another element of weakness in the scientific man, I venture to suggest that he is often less of a utilitarian than he should be. This is a sin, if it be such, which seems especially attached to those who, unconsciously or otherwise, are imitators of men of science of the highest type. The latter are so entirely absorbed in profound investigation, and their horizon is necessarily so limited by the very nature of

the operations in which they are engaged, that they are altogether unlikely to consider questions of utility; nor, indeed, is it desirable that they should. The evolution of processes and methods by means of which the complex existence of the present day is maintained is largely the result of specialization or the division of labor. In such a scheme there is room for those who never demand more of a fact than that it be a fact, of truth that it be truth. But even among scientific men the number of such is small, and as a class they can never be very closely in touch with the people.

Strong to imitate, even in those characteristics which are akin to weakness, many persons of lesser note affect a contempt for the useful and the practical which does not tend to exalt the scientific man in the opinion of the public. Even the great leaders in science have been misrepresented in this matter. Because they wisely determined in many instances to leave to others the task of developing the practical applications of their discoveries, it has often been represented that they held such applications as unworthy a true man of science. As illustrating the injustice of such an opinion, one may cite the case of the most brilliant philosopher of his time, Michael Faraday, who, in the matter of his connection with the Trinity House alone, gave many of the best years of his life to the service of his fellowmen. The intensely "practical" nature of this service is shown by the fact that it included the ventilation of lighthouses, the arrangement of their lightning-conductors, reports upon various propositions regarding lights, the examination of their optical apparatus, and testing samples of cotton, oils, and paints. A precisely similar illustration is to be found in the life of our own great physicist, Joseph Henry, who sacrificed a career as a scientific man, already of exceptional brilliancy, yet promising a future of still greater splendor, for a life of unselfish usefulness to science and to his countrymen as secretary of the Smithsonian Institution, as a member of the Lighthouse Board, and in other capacities for which he was especially fitted by nature as well as by his scientific training.

There is an unfortunate, and perhaps a growing, tendency among scientific men to despise the useful and the practical in science; and it finds expression in the by no means uncommon feeling of offended dignity when an innocent layman asks what is the use of some new discovery.

[Continued on p. 232.]

NOTES AND NEWS.

AN important experiment has been made in the province of the Don Cossacks, Russia, by M. Sherebzov. He collected the water from rain and the melting of the snows into two pools, holding together about 1,872,000,000 cubic feet, and distributed it among the fields in spring and summer. These pools supplied sufficient water to irrigate more than 2,290 acres, but were unable to contain all the water which flowed towards them; and therefore two new pools have been made, and the irrigated area enlarged to 2,960 acres. In consequence of this irrigation, says *The Scottish Geographical Magazine*, the wheat-crop has increased from about $9\frac{1}{2}$ to $15\frac{1}{2}$ bushels per acre; and the profits of the undertaking have been, according to M. Sherebzov, 30 per cent.

— Nothing in the wonderful history of photographic progress, which has been so strikingly rapid during the past few years, has been of greater importance than the development of what may be called, for want of a better term, "the photo-mechanical processes," which are so largely superseding wood engraving, steel engraving, and other pictorial methods. This subject is of great interest to the whole public, but particularly to all persons in any way interested in the production or use of pictorial illustrations: such as artists; authors; publishers of books, magazines, and newspapers; printers; and manufacturers whose products require illustration. For the past few years these processes have multiplied in number, have improved greatly in their results, and are every day assuming greater importance in both artistic and economical directions; yet it is a remarkable fact that in no exhibition have they been brought together for comparison and study. Beginning Nov. 3, 1890, the New York Camera Club will give an exhibition in its rooms, 314 Fifth Avenue, of the work of the various establishments producing all classes of such plates.

— Attention was drawn some months ago by *Engineering* to the very interesting experiments of Messrs. Mach and Salcher, who succeeded in photographing bullets in their flight. These experiments have been repeated with larger weapons, and the results previously obtained fully confirmed. To obtain a photograph, the camera is arranged at one side of the line of fire; and, as the shot passes a fixed point, it causes the discharge of a Leyden jar, the light from which is sufficient to allow of a photograph being taken. No results of any importance are obtained, according to *Engineering* of Oct. 3, till the velocity of the shot exceeds that of sound. But at higher speeds than this the photographs show that a wave of compression precedes the bullet in its flight. The shape of this wave is an hyperboloid of revolution with the apex of the hyperbola some little distance in front of the shell. Behind the shot a conical wave is formed, the angle of which is less, the greater the velocity of the shot. If the semi-vertical angle of this cone is a, the velocity of the shot is said to be

$$\frac{\text{velocity of sound in air}}{\sin a}.$$

— The greatest enemy to the plum is the insect commonly known as the plum curculio. This is the cause of the wormy fruit that so often falls from the trees. Various remedies have been tried for this pest, and for several years trials have been made at the Ohio Experiment Station of the method of killing the insects by spraying with a very dilute mixture of Paris-green and water. The experiments were again repeated this season by the station entomologist, Dr. C. M. Weed, with good results. An orchard of 900 bearing trees in Ottawa County, O., right in the heart of a great fruit growing region, was selected for the experiment. In the north half of it the method of catching the curculios by jarring on a sort of inverted umbrella mounted on wheels was employed, while the south half was sprayed four times with pure Paris-green mixed with water, in the proportion of four ounces to fifty gallons of water. The first application was made May 8, just after the blossoms had fallen from the late-blooming varieties. There was a heavy rain the same night, and it rained almost continuously until May 15, when there was a short cessation. The second spraying was done on that day. The third spraying was made May 26; and the fourth and last, June 2. On the jarred portion of the orchard a great many curculios were caught, showing that they were present in numbers. A careful examination of both parts of the orchard was made on June 3. Between one and two per cent of the fruit on the sprayed trees had been stung, while about three per cent of the plums on the jarred trees were injured. No damage to the trees was then perceptible. Early in July the orchard was again examined. Some of the sprayed trees showed that the foliage had been damaged by the spraying, but the injury was not very serious. Not over three per cent of sprayed fruit was stung at that time, while about four per cent of that on the jarred trees was injured. But on both the fruit was so thick that artificial thinning was necessary to prevent overbearing. A large crop of fruit was ripened on both parts of the orchard, and, so far as could be judged from the experiment, the practicability of preventing the injuries of the plum curculio by spraying was demonstrated. This process is very much less laborious and costly than jarring; and, if future experience is as successful as this season's work, plum-growing will become much easier.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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THE RELATIONS OF MEN OF SCIENCE TO THE GENERAL PUBLIC.

[Continued from p. 231.]

Referring to the theoretically extremely interesting spar prism of Bertrand, which under certain conditions may be used to detect traces of polarization of light, a recent writer remarks, "But for this application, the prism would possess, in the eyes of the true votary of science, the inestimable value of being of no practical utility whatever."

Much is said, everywhere and at all times, about the pursuit of science for the sake of science; and on every hand it is sought to convey the impression that one who has any other object in view in interrogating Nature than the mere pleasure of listening to her replies, is unworthy of a high place among men of science. So old, so universally accepted, so orthodox, is this proposition, that it is with much hesitation that its truth is questioned in this presence. In so far as it means that one cannot do any thing well unless it is done *con amore;* that pecuniary reward alone will never develop genius; that no great philosopher, or poet, or artist, will ever be other than unselfishly devoted to and in love with his work,—just so far it is true, although it does not, as is often assumed, furnish a motive of the highest order. It is a trite saying, but perhaps it cannot be too often repeated, that he who lives and labors in the interest of his fellows, that their lives may be brightened, that their burdens may be lessened, is, above all others, worthy of the highest praise. By this standard the value of a discovery must at last be fixed; bearing in mind, of course, that the physical comfort of man is not alone to be considered. Judged by this standard, the work of Newton, of Watt, of Franklin, Rumford, Faraday, Henry, and a host of others, is truly great. There should be, and there usually is, no controversy as to relative merit between the discoverer of a gem and the artist who polishes and sets it. In science the genius of the former is unquestionably rarer and of a higher order; but his work will always be incomplete, and in a great degree useless, until supplemented by that of the latter.

Another demand which the public may justly make upon the man of science is that his interest in public affairs should not be less than that of other men. Through his failure in this particular, science has long suffered, and is suffering in an increasing degree. This criticism is especially applicable in this country, where in theory every man is supposed to bear his share of the public burden, and to take his part in the performance of public duties. Unfortunately, the attitude of the scientific man is too often one of criticism and complaint concerning matters in the disposition of which he persistently declines to interfere. It cannot be denied, I think, that men well trained in the logic and methods of scientific research ought to be exceptionally well equipped for the performance of certain public duties constantly arising out of local, state, or national legislation; yet the impression is well-nigh universal that the scientific man has no genius for "affairs." Indeed, it has been more than once affirmed that he is utterly devoid of administrative or executive ability, and even that he cannot be trusted with the direction of operations which are almost wholly scientific in their nature. That there are many examples which seem to justify this belief is too true, but that there are other instances in which administrative and scientific ability have been combined is also true. Little search is required to reveal cases in which men of science have so ignored all ordinary rules and maxims of business procedure as to merit severe criticism, in which, unfortunately, the public does not discriminate between the individual and the class which he represents. It seems astonishing that one who is capable of successfully planning and executing an elaborate research, in which all contingencies are provided for, the unexpected anticipated, and all weak points guarded and protected, may utterly break down in the management of some much less complicated business affair, such as the erection of a laboratory or the planning of an expedition; and I am unwilling to believe that such failures are due to any thing other than culpable negligence on the part of the individual.

It is generally recognized, that, aside from all questions of a partisan political nature, this country is to-day confronted by several problems of the utmost importance to its welfare, to the proper solution of which the highest intellectual powers of the nation should be given. The computation of the trajectory of a planet is a far easier task than forecasting the true policy of a great republic, but those

qualities of the human intellect which have made the first possible should not be allowed to remain idle while an intelligent public is striving to attain the last. That men of science have not, thus far, made their full contribution to the solution of some of these great problems, is due to the fact that many have exhibited an inexcusable apathy towards every thing relating to the public welfare, while others have not approached the subject with that breadth of preparation in the close study of human affairs which is necessary to establish the authenticity of their equations of condition. As already intimated, we do not seem to be getting on in this direction. Our own early history and the history of other nations are full of examples of eminent scientific men who were no less distinguished as publicists and statesmen. The name of Franklin is imperishable alike in the history of science and of politics. On many questions relating to exact science, the Adamses spoke with confidence. Thomas Jefferson was a philosopher, and, on assuming the duties of the highest office in the gift of the people, counted his opportunities for association with men of science as one of its chiefest rewards. Other illustrations might be selected from the pages of the history of our own country; while in Europe, where science has been longer cultivated and under more favorable conditions, they are much more common. This is notably so in France, whose roll of scientific men who have distinguished themselves and their country during the past century, includes many names prominent alike for the importance of their performance in her various crises of peace and war. The present president of the French Republic, himself an engineer, bears a name made famous in the history of science by the rich contributions of his ancestors, one of whom voted for the execution of Louis XVI., and was a member of the Committee of Public Safety. It would be difficult to overestimate the value to science, as well as to the public, of the presence in the halls of legislation of even a very small number of men who might stand as exponents of the methods of science and as competent authorities on the results of their application. Our national Congress, especially, is almost constantly dealing with questions of great moment to the people, which can only be thoroughly understood and wisely dealt with by scientific men; and the presence of one or two such in each branch of that body would be of decided advantage to the whole country. In the nature of things, opportunities for such representation will be rare; but when they occur, they must not be suffered to escape.

Finally, if the conclusions reached in the foregoing should be thought wise, and should any young man at the threshold of his scientific career determine to be guided by them in establishing his relations with the general public, he will find splendid examples among the distinguished leaders of all departments of science. Should he desire to present the results of his labors in such a way that they may be understood by intelligent people, he may imitate Franklin, whose literary style, as to simplicity and clearness, commanded the highest praise from literary men; or Faraday, who was able to give expression to the most involved conceptions in simple English; or Tyndall, the appearance of whose "Heat considered as a Mode of Motion" was an epoch in the history of physical science, in its relation to an intelligent constituency, without which it cannot thrive. He will learn that there is no discredit in "popularizing" science; that popularizing what is not science is the thing that is to be shunned and prevented. The arrogance of genius is not less disagreeable than that of riches, although it is less common.

Should he wish to cultivate modesty in estimating his own attainments, he need only follow Newton, Darwin, and, in fact, the whole list of distinguished men of science down to the present time, with a few rare and unexplainable exceptions, the existence of which serves, like a whistling buoy, to point out what should be avoided.

Should he aspire to be of some use to the world and to leave it better because of his life, he will be encouraged by the fact, already considered, that in the long-run those discoveries are most highly esteemed, and justly so, which are the most potent in their influence upon civilization and society by ameliorating the condition of the people, or by enlarging their opportunities, and that all really great men of science have not lost sight of this fact; that "science for the sake of science" does not represent the highest ideal, nor can the "almighty dollar" ever be bartered for the "Divine Afflatus."

All of these questions will serve to enlarge his interest in public affairs, because he will come to recognize that he is himself but a part of the public. He will remember the delight of Faraday, when near the end of his life he saw a huge dynamo illuminating the tower of a lighthouse. That which he had given to the world as an infant, in his splendid discovery of induction, had, through the fostering care of others, grown to a brilliant manhood; and he experienced exquisite pleasure in the reflection that it might be the means of saving the lives of his fellowmen. The ideal of duty which ought to be present in the mind of every man of science may well be higher than that growing out of mere selfish pleasure in the acquisition and possession of knowledge.

Perhaps it is hardly becoming in me, at this time and in some sense representing this large body of scientific men, to make even a simple remark in criticism of the general public, the party of the second part in the question which we have considered to-night. I venture to suggest, however, that, whenever the public is disposed to consider its obligations to Science and her votaries, there are some things which must not be forgotten,—things so important and so numerous, indeed, that many volumes would be inadequate to their enumeration. Prove this by comparing the world *with* science, with the world *without* science. Take as an illustration that which less than two hundred years ago was but a spark—a faint spark—exhibited on rare occasions by the scientific man of that time. With this spark, thanks to science, the whole world is now aflame. Time and space are practically annihilated; night is turned into day; social life is almost revolutionized; and scores of things which only a few years ago would have been pronounced impossible, are being accomplished daily. Many millions of dollars of capital and many thousands of men are engaged in the development of this agent, so purely a creation of science that the Supreme Court of the land has already decided that it has no material existence. Surely science, which has brought us all these blessings, together with thousands besides, is worthy of every care and consideration at the hands of a generous and appreciative public.

THE CAUSE OF MOTION IN THE RADIOMETER.

It has been satisfactorily determined that the fly-wheel of the radiometer will not revolve in a bulb from which all residual gas has been removed, and that it will not revolve from the action of light from which heat has been eliminated. These determinations demonstrate that the motion of the fly must result in some way from the action of heat on the residual gas in the bulb. But beyond this, demonstration has not yet gone. The theory generally adopted by scientists is that the application of heat increases the vibration of the molecules of which the residual gas is constituted, and that, heat being more readily absorbed by the black sides than by the bright sides of the vanes of the fly-wheel, the molecules in contact with, or adjacent to, the black sides of the vanes thus become more heated, and vibrate with more force, than the molecules on the opposite side; and this increased vibration of the molecules against the black sides of the vanes pushes them around, thus causing the rotation.

Again, when the bulb has been heated and is cooling, the blackened sides of the vanes cool more rapidly than the bright sides, and consequently the vibration diminishes more rapidly on that side, and, the vanes being pushed by the greater vibration on the bright sides, the fly revolves backwards. This explanation is plausible, but it has not been demonstrated; and, with our present knowledge of molecules and of their vibrations, its demonstration is impossible.

There is another explanation equally plausible, which, I think, can be demonstrated. It is that the heat imparts to the residual gas in the bulb an impetus to motion in a direction radiant or tangential from the source of heat. If we suppose that the effect of heat on the tenuous matter in the bulb of the radiometer is to impart to it an impetus to move in a direction away from the source of heat, then all the results follow which are supposed to follow from molecular vibration. The particles of tenuous matter in contact with the blackened sides of the vanes, receiving more heat, would feel more intensely the impetus to radiant motion, and would push the vanes around; and again, when, in process of cooling, the greater heat is on the bright sides of the vanes, the particles in contact with that side, having the greater impetus, would push the vanes in the opposite direction.

The general effect of heat on matter is to increase its tenuity. By expansion, commencing with the solid form, heat reduces matter to the liquid, and then to the gaseous form, or, as in some conditions of matter, causes it to pass directly from the solid to the gaseous form without having become liquid; and, after reaching the gaseous form, the further application of heat increases the expansion and consequent tenuity, so far as has been observed, indefinitely. But if we suppose that matter, after reaching a certain degree of tenuity, begins to resist further expansion, the effect of the application of heat to matter in that condition would be necessarily to put the matter in motion in a direction radiant from the source of heat; and this motion would continue until the matter reached a temperature where no expansion was required.

Motion, or increase of tension, which is merely resisted motion, must result when heat is applied to matter; and, if the matter resists expansion, it must move to a place where no expansion is required, unless restrained by a countervailing force.

After various efforts to find some means of determining whether the motion imparted by the heat to the residual gas in the radiometer was vibratory or radiant, it occurred to me that a simple and satisfactory test could be found by applying radiant heat to the bulb from all directions at the same time. If the motion was caused by increased vibration, it could make no difference from what direction the radiation came; but if the motion was the result of an impetus imparted to the residual gas to move in a direction radiant from the source of heat, then, if the radiation came from all directions at once, the impetus to motion in any given direction would be counteracted, and the fly would not move. Some crude experiments, such as could be made by an amateur without skill or facilities, show very clearly, according to this test, that the motion of the residual gas is radiant from the source of heat, and not mere vibration.

A piece of iron pipe four inches in diameter was heated sufficiently to cause the fly of the radiometer to revolve rapidly when brought within three or four inches of it; and the radiometer was then suspended inside of the pipe, the fly being about three inches from the top of the pipe. The fly at first revolved very rapidly, but in a few seconds began to move slower, and at the expiration of three minutes had come to a full stop. I had no thermometer which could measure the temperature inside the pipe, but it was sufficient to char paper. The radiometer lost some of its delicacy by the heating, but the experiment was repeated with the same radiometer, and with the same result. The heated pipe caused the fly to revolve when the radiometer was brought near it on the outside, but stopped in a few minutes when the radiometer was suspended inside of the pipe.

To be certain that the injury to the radiometer in the first experiment did not affect the result, two new and very delicate radiometers were obtained. These were suspended from a rod so that while one hung in the pipe, the other would hang on the outside two inches from the pipe. The pipe was again heated, but more carefully, so as not to injure the radiometers; and they were suspended, one on the inside, and the other on the outside, of the pipe. The fly of the radiometer on the inside of the pipe revolved at first very rapidly, but in a few seconds began to go slower, and finally stopped; while the one on the outside kept up a steady motion, diminishing in speed very slowly as the pipe cooled. The experiment was repeated; the radiometer which had been on the outside of the pipe in the first experiment, being placed this time on the inside. The result was the same: the fly of the inside radiometer stopped, while the fly of the one outside of the pipe continued to revolve. Unless there is something in the nature of molecular vibration which has escaped my comprehension, it is impossible to account for the difference of effect in these two radiometers, operated on from the same source of heat, on any theory of vibratory motion in the residual gas; but it is just what ought to result if the heat imparts to the residual gas an impetus to motion radiant from the source of heat.

The importance of this determination is the chief reason for doubting its accuracy; but, surely, enough has been indicated to induce those who have the requisite skill and facilities to continue the experimental work until the question is satisfactorily settled.

The proposition that heat applied to highly tenuous matter imparts an impetus to motion in a direction radiant from the source of heat, explains the puzzling phenomena of comets' tails. "The tail, or train," says Professor Young (*General Astronomy*, art. 727), "is a streamer of light which ordinarily accompanies a bright comet, and is often found even in connection with a telescopic comet. As the comet approaches the sun, the tail follows it much as the smoke and steam from the locomotive trail after it. But that the tail does not really consist of matter simply left behind in that way, is obvious from the fact that, as the comet recedes from the sun, the train precedes it instead of following. It is always directed away from the sun, though its precise position and form are to some extent determined by the comet's motion. There is abundant evidence that it is a material substance in an exceedingly tenuous condition, which in some way is driven from the comet and then repelled by some solar action."

Professor Newcomb thus describes the phenomenon (*Popular Astronomy*, pp. 413, 414): "It has long been evident that the tail could not be an appendage which the comet carried along with it, and this for two reasons,—first, it is impossible that there could be any cohesion in a mass of matter of such tenuity that the smallest stars could be seen through a million miles of it, and which, besides, constantly changes in form; secondly, as a comet flies around the sun in its immediate neighborhood, the tail appears to move from one side of the sun to another with a rapidity which would tear it to pieces and send the separate parts flying off in hyperbolic orbits, if the movement were real. The inevitable conclusion is, that the tail is not a fixed appendage to the comet which the latter carries with it, but a stream of vapor rising from it like smoke from a chimney. As the line of smoke which we now see coming from the chimney is not the same which we saw a minute ago, because the latter has been blown away

and dissipated, so we do not see the same tail of a comet all the time, because the matter which makes up the trail is constantly streaming outwards, and constantly being replaced by new vapor arising from the nucleus. The evaporation is, no doubt, due to the heat of the sun; for there can be no evaporation without heat, and the tails of comets increase enormously as they approach the sun. Altogether, a good idea of the operations going on in a comet will be obtained if we conceive the nucleus to be composed of water or other volatile fluid, which is boiling away under the heat of the sun, while the tail is a column of steam rising from it.

"We now meet a question to which science has not yet been able to return a conclusive answer,—'Why does the mass of vapor always fly away from the sun?' That the matter of the comet should be vaporized by the sun's rays, and that the nucleus should thus be enveloped in a cloud of vapor, is perfectly natural, and entirely in accord with the properties of matter which we observe around us; but, according to all known laws of matter, this vapor should remain around the head, except that the outer portions would be gradually detached, and thrown off into separate orbits. There is no known tendency of vapor, as seen on the earth, to recede from the sun, and no known reason why it should so recede in the celestial spaces."

The uniformity of nature justifies the inference that the tendency of highly tenuous matter to recede from the source of heat, here observed in the celestial spaces, will certainly be found in terrestrial matter when we reach the requisite conditions. The first supposition of Mr. Crookes, namely, that the rays of heat exerted a propelling force on the solid matter of the vanes in vacuum, has no analogy in the phenomena above described; but the hypothesis that the rays of heat exert this force on the residual gas in the bulb seems to be entirely in accord with what occurs in the celestial spaces. The cometary matter, having become extremely tenuous, is put in motion in a direction radiant from the sun, the source of heat. It was in the effort to find operative in terrestrial matter the force which causes the projection of a comet's tail, that my attention was attracted to the consideration of the cause of motion in the radiometer.

The tenuity of the matter in the bulb can be measured; and it would be interesting to know at what degree of tenuity the phenomenon will appear, when it reaches the maximum, and when, as perfect vacuum is approached, it disappears. It is evident that the phenomenon results from the tenuity, and not from the temperature, of the residual gas; for a radiometer immersed in melting ice and salt, and exposed to the sun, will revolve rapidly. Heat causes tenuity by expansion, and during this process heat is absorbed: but it seems from this determination, that, when a certain degree of tenuity is reached, matter begins to lose its capacity to absorb heat by further expansion, and then it develops the tendency to recede from the source of heat, the tendency increasing with increase of heat and tenuity. The work of pushing around the fly in the radiometer requires a momentum which is the product of the impetus and mass of the residual gas in the bulb; and, whether the motion be vibratory or tangential, it is possible to reduce the mass of gas in the bulb to so small a quantity that no possible impetus would put the fly in motion.

The phenomenon of incandescence also seems to indicate that matter reaches a condition of tenuity at which it begins to resist further expansion. In his beautiful description of the phenomena of combustion and incandescence in his "New Chemistry," Professor Josiah P. Cooke leaves no doubt that the incandescence incident to combustion results from the resistance of matter to heat-work. It is true that he does not refer to this as the cause of incandescence, but he shows most clearly that ordinary heat-work in matter is to produce chemical re-action or expansion, or both: and, when these are free and unrestricted, no incandescence appears; but when this work is resisted, incandescence results. Vibratory motion always results from two forces, that is, from force resisted; and, light being a form of vibratory motion more intense than that of heat, it is certainly not improbable that the light from combustion is the result of the resistance of matter to the less intense vibratory motion of heat. Assuming this to be true, we have a very simple explanation of the incandescence of highly tenuous matter. The Geissler tubes, Crookes's tubes, Tyndall's tubes, and many other phenomena, demonstrate that highly tenuous matter becomes incandescent from the application of heat at a temperature far below that required for incandescence in matter less tenuous; and the same thing seems to occur in a comet's tail, which shines with a light of its own, and in the *aurora borealis*.

If it be true that when matter reaches a certain degree of tenuity it begins to resist further expansion, we ought to expect it to become incandescent at low temperatures, the temperature at which the phenomenon would occur being determined by the degree of tenuity. Professor Tyndall was not looking for this law in his experiments, but they come very near demonstrating its existence.

The proposition that matter at a certain degree of tenuity resists further expansion, and for this reason, on the application of heat, is put in motion in a direction radiant from the source of heat, and becomes incandescent at low temperatures, does not involve a denial of the molecular theory of matter, nor of the kinetic theory of gases. The proposition is entirely consistent with the theory that matter is composed of molecules, and that in the gaseous form, or in any other form of matter, these molecules are in constant vibration. It simply requires us to admit, that, if there be molecules in vibration, the vibration, like every thing else in nature, can go so far, and no farther. It does require us to deny the deduction from the kinetic theory to the effect that the vibrations are infinite, and that if the molecules of gas "were in space, where no external force could act on them, they would fly apart and disappear in immensity." But this is a mere vagary without legitimate parentage either in reason or experiment, and ought to be discarded from physical science even if the proposition here presented is not established. A much more serious objection to the proposition will come from those who have accepted the motion of the radiometer as visible evidence of molecular vibration. There is something intensely enticing in the idea that we have a wheel revolved by these scientific elves, and the theory has taken deep root in the minds of scientists in this country and in Europe. But the proposition here presented, if it can be scientifically established, opens the way to determinations in respect to the constitution of nature of far greater importance than any here mentioned; and I earnestly hope that some competent scientist will take up the subject, and continue the experimental work until no doubt remains. DANIEL S. TROY.

BOOK-REVIEWS.

Harvard Historical Monographs. Edited by ALBERT B. HART. No. 1. The Veto Power. By EDWARD C. MASON. Boston, Ginn. 8°. $1.

THE study of history is now carried on quite extensively in this country, and new works are constantly appearing; but we cannot say that many of them have a very high value, while not a few are almost unreadable. We are glad, therefore, to meet with a work of the kind that is somewhat superior to the mass, and such a work we have in this pamphlet by Mr. Mason. It has, indeed, no particular excellence of style, but it shows more thought and more political intelligence than is usually the case with such works. The author has not only studied his facts with great care and diligence, but discusses the principles involved, and often with much acuteness. He gives a brief chronological list of all the bills that the Presidents of the United States have vetoed, with an extended account of the more important ones. The body of the work is divided into chapters dealing with the different classes of vetoes, and showing their significance. The constitutional questions involved in the use of the veto power, and also its bearing on party politics, are carefully noted; and, though the author has confined himself to the national government, his work will be of interest and of real use both to students of history and to practical politicians. This series of historical monographs has been well begun, and we wish it good success; but we trust that the writers will not confine themselves to American history nor to the history of politics, but will treat the whole subject of the past life of humanity.

LETTERS TO THE EDITOR.

Reversal of Temperature in Lows and Highs.

DR. HANN of Vienna has taken serious exception to some of the views advanced in *Science* for June 6, 1890, and has published an article in the September *Austrian Meteorological Journal* in which he forcibly advances his views. I shall have no time for a controversy on this question, but it seems to me that its importance demands a passing notice of this last discussion. It is possible that we are not fully agreed as to the question at issue. I give my understanding of it. Is there a reversal of temperature in the centre of our lows and highs as we ascend in them? I use the terms "low" and "high" to replace exactly "cyclone" and "anticyclone," the words used in Europe. "Cyclone" was first applied by Piddington to severe West India and other tropical storms, and should be reversed for that purpose, as is carefully done by our Signal Service. The word "anticyclone" is very awkward, and should be discarded. The words "low" and "high" represent exactly what we see on our maps, and have been applied to these phenomena now these twenty years. I make this explanation, because I find that our discussions are being read in Europe, and they may not be entirely plain. The word "cyclone" is probably the most abused of any in this country. The scientist applies it to a storm perhaps 1,000 miles in diameter, with winds circulating about it from right to left, and of no great violence. Probably 64,000,000 people, at least, refer the term to a most violent outburst, not more than 50 to 200 feet across at the earth, which has energy enough to demolish every substantial building which it encounters. Dr. Hann objects to the word "storm," because, forsooth, seafaring men have adopted it to represent a very high wind. We are permitted the use of the words "rain-storm," "hail-storm," "thunder-storm," "snow-storm," "wind-storm," "sand-storm," etc., and it seems a great pity that we cannot apply the word "storm" in a general sense when we wish to mention the accompaniment of any of these. We must be careful, however, not to confuse "storm" with "low."

Dr. Hann makes me contradict myself by assuming that I accept "the ordinary theories of storm-generation" in *Science* for June 6, and totally discard them in another *Science*. I am sure no one familiar with my views could charge that I accept ordinary theories in meteorology. If one quotes such views in a discussion for the purpose of advancing an argument, surely he does not accept them; and such quotation does not overthrow all his views given repeatedly.

Dr. Hann has failed to comprehend the argument I advanced regarding his earlier researches in this subject. He published as early as 1874 that in unsaturated air the theoretical diminution of temperature with height is not far from 1° F. in 183 feet, while in saturated air it was 1° F. in 300 to 400 feet. I assumed that in our highs the air was not saturated, while in our lows it was. I have changed the computation slightly, and have now determined the theoretical temperature at Sonnblick, and compared it with that observed.

Sonnblick Temperatures (F.).

	Low, or Cyclone.		High, or Anticyclone.		
	1874 theory.	1887 observed.	1874 theory.	1887 observed.	
Air	Saturated	Moist	Unsaturated	Drying	Air
Pressure..	Diminished	19.96 inches	Increased	20.83 inches	Pressure
Temperature	28°	3°	−4°	18°	Temperature

There seems to be direct contradiction here between the earlier theory and the later apparently observed facts. It may also be

Publications received at Editor's Office, Oct. 6–18.

FERNALD, J. C. The Economics of Prohibition. New York, Funk & Wagnalls. 515 p. 12°. $1.50.
HENDRICK, W. A Brief History of the Empire State, for Schools and Families. Syracuse, N.Y., C. W. Bardeen. 203 p. 12°. 75 cents.
HERMETIC Philosophy. By an acolyte of the "H. B. of L." Vol. I. Philadelphia, Lippincott. 184 p. 12°. $1.
MACY, J. Our Government: How it grew, what it does, and how it does it. Boston, Ginn. 296 p. 12°. 85 cents.
MASON, E. C. The Veto Power. (Harvard Historical Monographs, No. 1.) Ed. by Albert Bushnell Hart, Ph.D. Boston, Ginn. 232 p. 8°.
NATURAL Speller and Word Book, The. New York, Cincinnati, and Chicago, Amer. Book Co. 166 p. 12°.
NEWHALL, C. S. The Trees of Northeastern America. New York and London, Putnam. 250 p. 8°. $2.50.
RELIGIOUS Instruction, Manuals of. From the Writings of Emanuel Swedenborg New York, The New-Church Board of Publication. 288 p 24°. 50 cents.
WELSH, A. H. A Digest of English and American Literature. Chicago, S. C. Griggs & Co. 378 p. 8°. $1.50.

said that upon this earlier theoretical computation depends a great deal of the present theory of the generation of storms.

Dr. Hann tries to show by observations at Pic du Midi, Feb. 19–March 14, 1883, that the lowest pressure at that station did not accompany a high (anticyclone) at the base. It seems to me that this case establishes my position; and if Dr. Hann still insists that he is right, in the face of these observations, there is no possibility of our coming to an agreement, but others must settle the point between us. I have repeatedly insisted that we must discuss conditions at the centre of low and high only, and that we can never take a diminished or a low pressure either at the base or summit of a mountain to indicate that the centre of a low (cyclone) is passing over. It is also probable that there must be added to this, that the low or high must advance at some velocity from a westerly direction, or they must have simply their normal condition, as in the United States. In Europe I find tracks of both these conditions exceedingly erratic, frequently wandering toward the west, then again stopping, especially highs, for a week or more. We are almost totally unacquainted with such conditions in this country. It seems highly probable that the general acceptance of Espy's stationary low (cyclone) theory by the authorities in Europe is largely due to this cause. A velocity of forty miles an hour (eighteen metres per second), such as we encounter in this country, might stagger our Eastern meteorologists. In the case given by Dr. Hann there is a steady fall of pressure at Pic du Midi and Toulouse from about March 5 to March 10. On examining the weather-map, I find a wandering low moving erratically just before and up to March 9. It has very little intensity as we regard them in this country, and cannot be taken as a typical low (cyclone) in any sense. On the other hand, a high (anticyclone) appears in Spain on March 10, exactly the condition I have insisted on. In any event, it is plain that the low temperature is due to the strong northerly and north-westerly winds induced by the high and low combined, and has absolutely no connection with the distribution of temperature in a vertical direction in the centre of a low (cyclone). The low does not approach Pic du Midi till March 9, when it is in North Italy. How any one can think that such a position of the low can have any bearing on this discussion seems impossible to understand. The low temperature at the summit undoubtedly was a factor in keeping down the pressure there.

Dr. Hann attempts to show that on the approach of a low on Mount Washington the temperature rises, owing to south and south-east winds in front. Loomis proved many years ago that the circulation in a low at sea-level does not take place at Mount Washington, so this speculation falls to the ground. It seems to me the discussion published in *Science*, Sept. 5, settles this question beyond a peradventure, although it would be a matter of gratification if some one else should be induced to repeat the investigation. I have just received a letter from Dr. Lüring of Germany, who has studied the matter thoroughly, and who agrees with my position that there is no reversal of temperature in a low, but is not quite willing yet to accept the same for a high. It seems to me the evidence is all one way, and that, if we accept the results of this investigation in the case of a low, we must do so also in that of a high.

H. A. HAZEN.

Washington, Oct. 10.

AMONG THE PUBLISHERS.

A BOOK has appeared from the press of Lippincott entitled "Hermetic Philosophy," by an acolyte of the "H. B. of L." It is the first of a series of works which the author proposes to write, expounding the principles of theosophy as taught in ancient and modern times, and especially as held by himself. It consists in part of matter borrowed from Plato and Plotinus, but in the main it expresses the ideas—or want of ideas—of the author. It has, of course, the usual character of such works; and, as usual, we are

told that it cannot be understood by ordinary intelligence,—a fact that we are not inclined to dispute. We did, however, find one proposition in the book which we not only understood, but believed. We read on p. 61 that "that which is immortal is not mortal; that which is mortal is not immortal." This we solemnly believe to be true, and we can only regret that the rest of the book is not equally valuable.

— Messrs. Funk & Wagnalls will publish in November a narrative poem in blank verse by William Cleaver Wilkinson, entitled "The Epic of Saul." The poem treats of the career of Saul the Pharisee up to the time of his conversion. Passages of the "Epic of Saul" have appeared in *The Century*, *The Independent*, and other periodicals, entitled as separate poems.

— *The Chautauquan* for November presents, among other articles, the following: "The Intellectual development of the English," by Edward A. Freeman; "The English Constitution," II., by Woodrow Wilson; "The Religious History of England," II., by Professor George P. Fisher; "How the Saxons Lived," Part II., by R. S. Dix; "The Tenure of Land in England," Part II., by D. McG. Means; "The Knight of the Round Table," by James Baldwin; "The Silver Bill," by Thomas H. Hamilton; "Studies in Astronomy," II., by Garrett P. Serviss; "How to see Southern Italy," by J. P. Mahaffy; "The Origin in Literature of Vulgarisms," by Professor Edward A. Allen; "Light-Houses and Other Aids to Navigation," by William Mooney; "Observations on Greenland," by Charles M. Skinner; "Silk Industries in France," by Albert de la Berge; "Home Building," I., by Byron D. Halsted.

—Herbert Ward, the African traveller, in "The Tale of a Tusk of Ivory," in the November *Scribner*, says, "From time immemorial the smooth, shining tusks of elephants have been acknowledged as currency by the savage tribes of the far interior of Equatorial Africa; and even in these days countless numbers of human lives are sacrificed in the bloody fights which are constantly waged, both between the tribes themselves and the armed bands of half-caste Arab freebooters, solely for the sake of gaining possession of these tusks of ivory, which, by a series of novel exchange and bartering transactions, gradually reach the little stations of the white trader on the surf-bound coast." Professor N. S. Shaler, in his ethnographic researches, sought the record of a body of troops whose ancestors had been for many generations upon American soil, and he found it in the first brigade of Kentucky troops (Confederate). He says, "On May 7, 1864, this brigade, then in the army of Gen. Joseph Johnston, marched out of Dalton, 1,140 strong, at the beginning of the great retreat upon Atlanta before the army of Sherman. In the subsequent hundred days, or until Sept. 1, the brigade was almost continuously in action or on the march. In this period the men of the command received 1,860 death or hospital wounds; the dead counted as wounds, and but one wound being counted for each visitation of the hospital. At the end of this time there were less than fifty men who had not been wounded during the hundred days. There were 240 men left for duty, and less than ten men deserted. A search into the history of warlike exploits has failed to show me any endurance of the worst trials of war surpassing this." It is doubtful whether the survey of the great railroad in the Andes surpassed in danger and stirring adventures the exploits of the engineering party led by Robert Brewster Stanton last winter through the cañons of the Colorado. In less than 500 miles 520 rapids, falls, and cataracts were encountered. Mr. Stanton will describe this expedition in the November *Scribner*. A series of photographs was taken, some of which will be used to illustrate the article. A number of nurses in the New York City Training School have written for Mrs. Frederick Rhinelander Jones (who offered prizes for the best) sketches of their actual experiences in a typical day, or night, of hospital work. These will be embodied in Mrs. Jones's article "On the Training of a Nurse," also in the November number.

CALENDAR OF SOCIETIES.

Biological Society, Washington.

Oct. 18.—H. E. Van Deman, Cultivated Fruits in the Mountains of North Carolina; T. N. Gill, On the Super-Family Cyclopteroidea; Lester F. Ward, American Triassic Flora.

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THE AIM AND FUTURE OF NATURAL SCIENCE.[1]

THE aim of science is twofold: we study science that we may know the truth, and that we may utilize that truth for the material and moral advantage of humanity. Of these two aims, the higher and less common is the former. Many persons will naturally inquire what advantage there can be in seeking truth for its own sake only; yet nearly all the practical applications of discovered truths have been based upon principles which have been attained, not by the so-called practical men, but by those whose lives were devoted to what has been opprobriously called the "mere getting of knowledge." It was with perhaps no slight tinge of sarcasm that Pilate exclaimed, when brought face to face with Jesus of Nazareth, "What is truth?" Nevertheless, to this question man has, from his earliest appearance upon this planet, sought for a reply; and, so long as man shall exist as man, he will never abandon his search. One form of this search is curiosity, and we call it idle; but it is far from idle in its origin. It is the insatiable desire, inborn in every man, to find out that which he does not know. It is this which led a Galileo to the torture, and a Bruno to the stake; it is this that has caused men to forsake family and friends, devoting their wealth and health, and all that the world calls happiness, to seeking truth. The little child at its mother's knee begins to imagine the why of the phenomena surrounding it; and the old man sinks into his grave, still pondering on the unsolved problems of life which he must abandon, hoping that in another world he may find the key to the mysterious hieroglyphics he leaves behind. Perhaps the origin of this desire rests on the fact that in nature itself, formed by the Almighty, we find the marks of His fingers. By studying science we are but studying His methods of working in the natural world; and thus we are like Job of old, by searching, trying to find out God. It is often lost sight of, that nature is just as true a revelation of the Deity as is the record of the Book of books; and the scientist, no less than the theologian, is a student of God and his laws. What we call natural laws are but our formulations of the method by which God has worked in nature. The study of astronomy is the study of his universe; the study of geology, the study of how he fashioned this planet; the study of evolution, but the study of God's methods of creating all living plants and animals. The time will come when religion will look back to Newton and Kepler, Dalton and Joule, Darwin and Wallace, as God's interpreters, no less truly than to Augustine and Chrysostom, Luther and Calvin, Butler and Edwards.

[1] Lecture delivered before the Polytechnic Society of Kentucky, May 26, 1890, by James Lewis Howe.

But there is another aim of the study of natural science which is to the vast majority of mankind far more practical. It consists of study for the purpose of utilizing the principles of science for the benefit of mankind. From one standpoint this aim is philanthropic, in that it seeks to use its discoveries for the comfort and convenience of mankind. This aim is hardly less worthy than that of the pursuit of science for the sake of finding truth; but in far too many instances the incentive is not any feeling of philanthropy, but merely the acquisition of personal financial gain. In the constant struggle for the "almighty dollar," Science proves herself a valuable aid, but it is only by her prostitution. In the spirit of pursuing science merely for the money it will enable one to make, the true aims of science are wholly lost sight of; and it seems often as if unhappily by far the greater number of the devotees of science are devotees merely for the money in it, like the money-changers whom Christ drove from the temple precincts. The temptation which is continually offered to leave the paths of pure science for the sake of following industrial paths is very great, and is in danger of wholly obscuring, or at least of allowing to fall into the background, the true aims of science. Of course, incidentally the human race is vastly benefited by the attainments of those who have no thought but of gain; nevertheless it cannot fail to lower science in the eyes of thinking men. Many great discoveries of the last few years have been very valuable for the world; but often, too, they have given rise to vast and grinding monopolies. It is almost alone in the sphere of medicine that the profession have kept their standard so high; and it is by them universally held that any great discovery is the property, not of its discoverer, but of all humanity. The true scientist would far rather be a Jackson or a Koller, and give to suffering mankind the wonderful alleviators of pain, ether and cocaine, than to amass millions through some patent monopoly.

Look for an instant at the vast multitude of patent-medicine advertisements which cover our fences and walls, and fill the columns especially of our religious papers. What are we to think of a man, who, if his claims be true, possesses a specific that will cure every case of consumption, or bright's disease, or some other ill of flesh with which the regular practitioner admits he is wholly unable to cope—what are we to think of such a man, when he will part with his discovery only in payment of an outrageous fee, and who will suffer hundreds and thousands to suffer and perish, in order that he may make a fortune? Is he one whit better than the physician who would allow a patient to die rather than treat him, when there was no hope of his bill being paid? The one

we call inhuman, into the coffers of the other we pour our millions. It seems to me we err when we consider any discovery of the truth whatsoever as the property of its discoverer. It is true that he who labors with the mind should receive a reward for his work, just as well as he who labors with his hand. But even our patent system does not acknowledge a man's property in his discovery: it merely gives him a monopoly of it for a few years, and then it comes into the possession of mankind, to whom it all the time belonged. There may be much fallacy mixed up with what truth there is in Edward Bellamy's "Looking Backward;" but there is no doubt but that the greed for gain is one of the darkest of the stains upon the escutcheon of our boasted nineteenth-century civilization.

Happily and naturally the great discoveries of the world have not proceeded from this avaricious spirit. As a rule, the aim has originally been solely to seek truth. It is only when the discovery has been made, that the temptation has proved too strong, and the worshipper has turned his back on the pure shrine of truth, and bowed his knee to the shrine of Mammon.

Having thus sketched briefly what appears to me the true aims of science, it is my purpose now to consider the rapid growth of science in the past, and from this, as far as it may be possible, to point out the as yet unconquered fields and the hints of what we may expect of science in the future. Down to the time of Aristotle, natural science can hardly be said to have had any existence. Here we find its dawning, when the method of deducing the law from the individual phenomena was first proposed by that far-seeing philosopher. It was, however, but the dawning, and the day was long in breaking. All through the later civilization of Rome, and through the dark ages, the advance was at a snail's pace. Alchemy recognized the true aim,—search for truth,—but to attain this aim resorted to such deception, that her lack of fidelity to the truth retarded the development of true science many centuries. Roger Bacon with prophetic vision foresaw the day that was soon to break, even as his more illustrious but infamous namesake of Verulam realized, as no other of his time, what that day would bring. Kepler, Galileo, and Newton caught the first glimpses of the rising sun, and from their time to ours the progress has been with ever accelerated velocity.

Of the four great generalizations of natural science thus far discovered, but one dates back of the present century,—that of universal gravitation. The importance of this discovery cannot be overestimated, inasmuch as this was the first time an attempt had been made to include universal phenomena under a single law. We, with our modern knowledge, are apt to underestimate the effect of thus introducing the new principle of universal generalization into science. True, Newton did not explain the cause of gravitation, nor can we. It remains for some future philosopher, some greater Newton, to show how matter can act on matter at a distance, if it does; to show us whence came that runaway star crossing the great starry disk of the universe at inconceivable speed, what force set it going, and whither it tends; to tell us why the tail of the comet is repelled by the sun, and not attracted, as all material bodies should be; to explain to us the relation existing between what we call matter and the so-called luminiferous ether. It seems to us to-day as if gravitation were but a special instance of some greater, infinitely farther-reaching law, by which cohesion and chemical affinity, and a host of other phenomena to-day inexplicable, will all be made clear. Such a generalization the science of the future may hope to make.

With the opening of this century, science began to make rapid strides. The chemist of the last decades of the last century began to suspect the indestructibility of matter, and under Berzelius and Lavoisier quantitative analysis became well established. It seems strange to us to-day that such an idea as the annihilation and creation of matter could have ever been held: and yet when we think of the burning of a piece of wood or coal, with only a bit of ashes left, the other products of the combustion having vanished into thin air; when we think of the solution of a piece of iron or zinc in acid with the liquid apparently unchanged; when we think of the coating of copper formed on a knife-blade immersed in a solution of blue vitriol; when we think of how our fathers were taught that heat was a material substance which mysteriously entered into or left other substances under certain conditions,—our wonder becomes less. It remained for a Dalton to open this century with the second great generalization of science, the atomic theory of matter, which includes within itself the idea of the permanence of matter. To him all matter was made up of atoms, infinitesimal in size, unchangeable, and few in species; but by the union of the different kinds of atoms all the multiform substances which we know arise. It is true that we find the idea of the atomic constitution of matter more than hinted at in the old Greek philosophers, and some have sought to show that Democritus and Empedocles were the real originators of the theory. But to these Greeks the atoms were but philosophic abstractions, perhaps we might better say clever guesses: to Dalton they were experimental facts. The investigations of later chemists have justified the views of Dalton, and yet have shown their incompleteness. Mendeljeff and Newlands and Victor Meyer have demonstrated the close dependence of the properties of any element on the weight of its atoms, thus enabling them to predict the properties of elements then unknown, but whose subsequent discovery has verified their predictions. Crookes has shown the probability that what we call elements in many cases may not be true elements, but mixtures of elements so closely similar that he calls them "meta" elements. Many chemists have hazarded the guess that all our elements are in reality not simple, but compounds of some one as yet undiscovered, absolutely simple element; and it remains for the chemist of the future to point out the true nature of the chemical atom.

After the time of Dalton, chemistry received an impetus greater than any it had heretofore received, by what we can characterize as the discovery of organic chemistry by Wöhler in 1828. Up to this time the existence of so called vital force had been almost universally believed in. Under the influence of this force arose all the phenomena which we call life, and which were thought to be wholly different from all other phenomena, and beyond the study of man. Substances which were formed by life it was supposed could be formed in no other way, inasmuch as life force was a force which must ever elude man's investigations. But quite by accident Wöhler formed the first organic substance from one with whose formation life had had nothing whatsoever to do. For

years the truth of his discovery was denied by philosophers; but the chemists pursued the even tenor of their ways, multiplying continually the number of organic substances artificially formed, until to-day the field of organic chemistry has manifold more investigators than that of its elder sister, inorganic chemistry. Thousands, we might say millions, of organic substances have been formed. The dye-stuffs turkey-red and indigo, as well as hundreds of the aniline dyes so called, the formation of which Dame Nature has never attempted, and many alkaloids, are chemistry's best reproductions of nature's work; and within a few months grape and fruit sugar have yielded up their secrets. Few will be the years, perhaps months, before even cane-sugar, and morphine and quinine, will be in the list of the chemist's triumphs. Indeed, there is hardly a substance which nature can form that the chemist despairs of reaching. And why not, when we consider that the same forces are at his disposal which Nature uses in her laboratory? Life is merely the director of these forces. Nevertheless we are not to consider, however great may be his attainments, that the chemist will ever form life itself. The living protoplasmic cell is something more than a complicated aggregation of complex molecules, that exists when life has left the cell; but not until we can make alive the protoplasm from which life has just departed can we hope to pass in our laboratories beyond the making of dead protoplasm.

Coming down to a date a little later than that of Wöhler, we meet the third great generalization,—that of the conservation of energy. Long after the idea of the permanence of matter had permeated science it was still believed that energy was controlled by no such law. The revolving wheel came to rest a moment after the force ceased to be applied; the rifle-bullet struck the wall, and its energy left it; the stone fell into the water, made a splash, and in a moment all was at rest (the energy in the stone had disappeared). It was only when it was realized that heat was merely a form of motion,—motion of the atom and molecule, and not of the mass,—that the conception became possible that energy, like matter, was imperishable. The wheel indeed stops, but its motion is lost by friction, and converted into heat: the molar energy has merely become molecular and atomic. The rifle-bullet has stopped, but it is hot, and the lost motion of the bullet is now making move more rapidly, and through longer paths, the molecules and atoms of the lead. The stone has fallen, but the water into which it fell has been warmed by that transferrence of energy; and it was Joule who showed that the heat which the water has received can be converted back into molar motion, and is just sufficient to raise the stone to the height from which it fell. Thus, while energy appears in protean forms, it is never lost; and this law we find to be no less true in the inorganic world than in the world of life. The work we do, and the heat of our bodies, are the exact equivalents of the combustion of the food we eat, with the oxygen of the air we breathe. This law has, since its discovery, formed a criterion in the judgment of the efficiency of all kinds of machinery, enabling the determination of the proportion of the energy applied as fuel or otherwise, which is utilized; and thus it further enables the saving of great amounts of energy by showing where the loss lies.

The acceptance of the fourth and last of the great generalizations of science is within the memory of most of my audience. I refer, of course, to the idea of evolution. That there had been a progressive development of species of plants and animals from their first appearance on the earth, was long ago believed. It was taught in the Arabian schools during the dark ages of Europe: we even find it hinted at in the apocryphal books of the Old Testament. Lamarck tried to explain it, and Darwin's illustrious grandfather seemed imbued with the theory. Goethe was on the verge of its discovery. But it remained for Charles Darwin to so present the evidence and to explain the plausibility of its truth, that the world of science should come to believe that evolution is a fact. More, perhaps, than any of the three earlier great generalizations of which I have spoken, was that of evolution far reaching in its influence. In little more than a quarter of a century we have seen the idea of evolution permeate the fields of history, philosophy, law, politics, philology, and even theology. It matters not in our present consideration whether or no it be a fact that man was developed from a lower form of life, whether or no life originated spontaneously from inorganic matter. These are points to be settled by evidence; and as to the evidence, scientists differ. These are but very special and minor applications of the generalization. The great idea which evolution emphasizes is that Nature does not move *per saltum*, but is uniform in her working; that God works according to what we call laws, and not arbitrarily, and that he will not suffer his highest creation, man, to be put to permanent intellectual confusion. In the application of evolution, Darwin sought to show how it was probable the development of organic nature was brought about. This does not affect the question of development of itself, which is a question of fact, to be accepted or rejected according to evidence. It has been accepted by the vast majority of all scientists; but the present work of biologists is to philosophize, as did Darwin, as to the why of evolution. He presented as chief cause the survival of the fittest in the struggle for existence; he later added sexual selection as a powerful factor; and other naturalists have proposed many other causes, more or less far-reaching in their influence.

Thus the study of evolution in the organic world to-day is a philosophy of evolution; and we may say that thus far there is comparatively little agreement among the philosophers. It remains as a great problem of the future, the solution of which perhaps none of us will see.

It is perhaps more to evolution than to any of the other great generalizations that the great progress science has made in the last quarter of a century is due; not, indeed, to its direct influence, but rather to the stimulus and impetus it has given. It perhaps might be said with truth that science has made more progress during each decade of the present century than it had made in all time previous to the opening of that decade. This is particularly true of the last ten years. While the advance here has been most largely in the realm of applied science, yet one discovery in the field of pure science ought not to be omitted, which may yet prove to be more far-reaching than we yet anticipate. I refer to the demonstration by Herz, that electricity, like heat and light, is a form of vibratory motion of what we call the luminiferous ether. To be sure, for many years it has been foreseen that this must be the case; but yet, when the dem-

onstration really comes, we are hardly prepared for the vast change in our ideas it occasions. We have been used, for the most part, to study electricity in conductors; but it now appears that this is but a special case, that we really must study electricity in the space around the conductors. Some go so far as to say that in the not distant future we shall have no more use for the words "heat" and "light," but our text-books on physics will treat in their place solely of electricity.

There is one other field of pure science to which I would like to refer this evening,—that of astronomy. When the Dutch scholar held two lenses together and saw distant objects brought near, he little thought of the revelations which would be made by the telescope of the future; he little thought of seeing the moon as if it were but ten short miles away, of viewing millions of stars where the eye sees none to shine; he little thought of seeing two miniature worlds revolving around the planet Mars,—worlds so small that we could pack several of them away in one of our Kentucky counties. It is, however, when we lend to our telescopes the aid of photography and the spectroscope that our knowledge of the universe outside of us becomes so almost infinitely enlarged.

From the spectroscope we have learned that the sun is composed of the same elements we know on our earth, that even the most distant star is but a sun like that of our solar system, that the comet is perhaps but a stream of meteors like those which our earth is continually meeting in its journey through space, that the material of all the universe is one. We learn more: for we see the genesis of worlds: nebulæ condensing to suns, and suns cooling to a state like our own luminary; and yet, further, we are, as it were, in the very presence of the creation and of the death of stars,—stages our system has millions of years since passed through, and those through which it will pass centuries after we are gone.

So, too, when we find upon the photographic plate the print of stars so far away that we cannot see them even in our most powerful telescopes,—stars from which the light-vibrations which have left their impress on the plate may have started long before the first man appeared on this earth,—we feel ourselves almost in the presence of infinity itself. Is there no end to the universe, no point beyond which there do not stretch worlds on worlds? Will the science of the future answer this? Who can tell?

Turning now from the, to my audience, perhaps less familiar field of pure science, to that which cannot fail to force itself upon the attention of every one, the applications of science, we find that probably the most important single discovery is that of the steam-engine. Who could have dreamed, when that little boy sat watching the cloud of steam from his mother's tea-kettle, of the millions of applications the world was to see in the next century? Who could have imagined, when he allowed his imagination its wildest flights, that through this power civilization itself would have been revolutionized?

Ages ago the energy of the sun was stored up in the vast coal-beds of every quarter of the globe. Until the discovery of the steam-engine, man had left all this source of energy untouched. To-day he is just beginning to realize the immense capacity for work presented to him; and yet how wasteful he is! It is for the scientist of the future to present a way that this energy can be fully utilized, since to-day, without thought for his descendants, man is scattering by far the greater portion of this energy to the air. A steam-engine which will return more than a few per cent of the possible energy of the coal is yet to be devised. Nevertheless, imperfect as the best steam-engine is, think of the improvement on the time of our grandparents! The annihilation of time and space has begun. We rush along the iron rail at a mile a minute quite as a matter of course, and a Boynton has promised us a trip from New York to San Francisco in a day; a week or less carries us across the Atlantic, and a George Francis Train needs but the time of a school-teacher's vacation to girdle the globe. Our latest journal brings us news that Jules Verne's "Twenty Thousand Leagues under the Sea" is no longer a fancy, but that the successful submarine boat has become a fact. Still More's Utopia has not yet been fully reached. The air remains as an unconquered field; but who can doubt that the time will come, and that perhaps in the not far distant future, when man will vie with the eagle in his flight, and thus friction, the great impediment to rapid transit, will be reduced to a minimum? "The birds can fly, and why can't I?" is not merely the foolish quandary of Darius Green: it is the sober inquiry of many engineers.

The advance in the field of applied chemistry is not behind that of engineering. Most striking is the cheap production of steel. From the days of the Kabyles, little advance had been made down to a comparatively recent date; but the invention of what is commonly known as Bessemer steel,—an invention, by the way, of one of our own citizens,—has opened the way to the replacing of iron by steel for a multitude of purposes, and presages the day when steel will almost completely take the place of iron. And yet prophets tell us that not steel, but aluminum, is the metal of the future. The price of this metal is continually being lowered, never more than within the past year or two; and it is certainly capable of many applications. It may be that even steel will not be able to hold its own, though I confess such is hardly my judgment.

In the field of applied chemistry is one of the best illustrations of the fact that if man can clearly state a problem, he can solve it. Napoleon offered a large reward if any one would devise a simple method of manufacturing soda from salt; and among the processes presented was one which is to-day still in use, practically unchanged in principle from Le Blanc's specifications.

With the developments of the soda industry has gone hand in hand that of soap-making. It is hard for us to believe that there could have existed a civilized people who did not use soap; but we are told the Greeks had no soap, and that the Romans used it only as a cosmetic. Still it is none the less true that, as has been said by another, it is possible to judge the standard of civilization of a nation by the amount of soap which it uses. Perhaps the two other most striking and most promising developments of applied chemistry are those of the synthetical formation of dye-stuffs and drugs.

Many of you doubtless remember the furor occasioned when the first aniline dyes were thrown on the market, and the fortunes made and lost. Yet who could have foreseen the

alm st infinite number of colors which we may to-day see, especially among the silks, in a dry-goods house? The color-sense of the modern European and American has developed in a wonderful degree in the last quarter of a century; and can we doubt that "rods and cones" have either undergone a remarkable increase in number, or else have been marvellously educated? The most striking of the advances in this line was the artificial formation of alizarine, the dye-stuff known as turkey-red, and which, preserved to us still unfaded as Egyptian mummy wrappings, justifies the biblical comparison of sin to "scarlet." Indigo has been in more than one way synthetically formed; and it is certain, that, even as the alizarine manufacture has completely ended the cultivation of the madder, so it will be but a few years before the chemist will vie with nature in the manufacture of indigo But it would seem that the industrial chemist does nothing half way. Not satisfied with imitating nature, the dye-stuff chemist has for his aim the production of colors of any wave-length or any combination of wave-lengths whatsoever, and he seems not to waver in his course toward this goal.

Salicylic acid, salol, antifebrin, sulphonal, and homatropin stand among the brilliant examples of what chemistry has done for the medical profession; but we shall look in the near future to the artificial formation of quinine and morphine, and any other drug that may be demanded. Perhaps here the field of physiological chemistry will in the future hold sway, and we may live to see the time when the drug will be manufactured directly for the purpose of meeting certain symptoms. This looks by no means impossible, in view of the recent introduction of a large and ever-increasing number of antiseptics, antipyretics, and hypnotics. When it has once been determined what is the relation existing between chemical composition and physiological effect,—and this is to-day the field in which physiological chemistry has the most to hope,—then will the time have come when not only medicine will have been rescued from the bonds of empiricism and reduced to a science, but chemistry will be acknowledged as her handmaiden, furnishing the physician that special drug which will play the specific in each individual case.

This leads us to the field of medicine and surgery. Of course, the most marked advance in this department is the general acknowledgment of the germ theory of disease. It may be that in the majority of cases the peculiar germ of the disease has eluded discovery, it may be that the germ theory is but one side of the subject of origin of disease; nevertheless it is true that medicine and surgery, under the influence of this theory, are undergoing a marvellous change, which is destined to add months and years to the average life of man. Jenner walking in the darkness, and Pasteur in the twilight of early dawn, have traced the path which our successors decades hence will follow. We must not marvel if, in the dimness of early morning vision, all is not as clear to them as it will be generations hence, but rather wonder that in the faintness of the light they could have caught the first glimpses of the coming day.

We to-day can see clearly that the task of the physician of the future will be not so much to heal disease as to prevent it; and may we not look forward to the time when every germ of consumption and scarlet-fever and diphtheria, and other kindred diseases, will have been exterminated, even as the Diornis of New Zealand and the buffalo on Western prairies? This being the case, surgery will be robbed of its terrors, and its advances in the past decades will be as nothing to what the future has in store.

If I were asked to name the subject most attracting the scientific man of to-day, I should answer electricity; if I were asked to name the field in which there is the greatest opening for a scientist, I should say electricity. When looking at this field, we are looking at a field which is hardly yet in the earliest stages of infancy. To be sure, the application of electricity to the telegraph and telephone seems to us an old story; but the developments which must follow the recent discovery of Herz of the true nature of electricity will undoubtedly bear fruit in the improvement of these instruments. When we further take into consideration the subjects of electric lighting, electric motors, and electric welding, we have every thing to hope for the future. Indeed, now that we may consider the study of electricity founded upon a solid basis, the wonders which a few decades will bring forth cannot be foretold.

And now, were I asked to suggest the great problem which is to tax the ingenuity of the scientist of the future, I should say it would be the utilization of energy. To-day we have practically going to waste the energy of the sun and wind, and wave and tide, and even that of our great cataracts. We could hardly compute the infinitesimal proportion which is utilized by the various wind-mills and tide-mills, and turbines beneath Niagara. The stored energy of the sun in the carboniferous period still mostly remains unused by us in our coal-beds, but these will eventually be exhausted. Nevertheless the sun is to-day furnishing us just as much energy as then, and it only remains for the future scientist to devise some method for its utilization; and we cannot doubt this will be done. Again, the scientist of the future will devise some method by which the energy of fuel will be converted into electricity without passing through the stages of the steam-engine and dynamo, in which by far the largest portion is lost. The energy of the combustion of zinc is converted with little loss into electricity. Who will be the man to invent a battery in which the energy of the union of carbon with oxygen will be directly converted into electricity? When, still further, we to-day take the energy of coal and convert it into steam, thence into engine motion, thence into electricity, thence through the incandescence of carbon into electric light, we do it at tremendous loss. The glow-worm and the lantern-fly effect the same transformation with scarcely a trace of heat, and, as far as we know, with little loss. One of the greatest problems of the future will be the transformation of carbon energy into light in some similar way, when a single pound of combustible material will furnish us as much light as is now obtained through illuminating-gas or the electric light from a ton of coal.

And what now shall we conclude of the future? Will the time come when by improved machinery one man's labor will clothe and feed a hundred? Will our bread and meat be made for us by the chemist from coal and water and air? Shall we traverse the earth and air and water on the wings of the lightning? Will the vagaries of Edward Bellamy become facts, and money vanish, and with it avarice

and all its accompanying vices? Will the poet's dream come true?—

"Men, my brothers, men the workers, ever reaping something new:
That which they have done but earnest of the things that they shall do:

"For I dipt into the future, far as human eye could see,
Saw the Vision of the world, and all the wonders that would be;

"Saw the heavens fill with commerce, argosies of magic sails,
Pilots of the purple twilight dropping down with costly bales;

"Heard the heavens fill with shouting; and there rained a ghastly dew
From the nations' airy navies grappling in the eternal blue;

"Far along the world-wide whisper of the south wind rushing warm,
With the standards of the peoples plunging through the thunder-storm;

"Till the war-drum throbbed no longer, and the battle-flags were furled
In the parliament of man, the federation of the world.

"There the common sense of most shall hold a fretful realm in awe,
And the kindly earth shall slumber, lapt in universal law."

Whether these things will be realized we know not. In view of the past, we dare not say our wildest dreams and fancies will not to-morrow be realities. But this we know: that wherever it is possible to benefit mankind, to alleviate suffering, to elevate humanity, and to raise man more nearly to the true image of his Maker, there the aid of natural science will never be found wanting.

THE SECOR SYSTEM OF MARINE PROPULSION.

FOR over four years there has been in process of development in the city of Brooklyn a system of propelling vessels which it is believed will offer distinct advantages over the marine steam-engine. The following is a brief description, condensed from "General Information Series," No. VIII., of the United States Navy Department, for 1889:—

"The propulsion of vessels by the liberation of a large volume of gas by explosion and the displacement of water thereby has been tried, and has met with some success.

"The method employed is the invention of Mr. Secor, and is fitted to a vessel 100 feet in length, called the 'Eureka.'

"The apparatus consists of two horizontal tubes about twenty inches in diameter, placed fore and aft in the after part of the vessel below the water-line, the after ends being in communication with the sea. Petroleum in the form of spray, and air under pressure, are injected into the tubes at the forward ends, and exploded by electricity. The disengaged gas expels the water from the tubes, and the re-action against the forward ends of the tubes propels the vessel. The explosions are arranged to take place alternately in the cylinders, and the firing mechanism to work automatically. Sixty explosions a minute in each cylinder have already been obtained, giving quite a uniform motion."

In 1824 Sadi Carnot propounded the great principle that the useful effect of any heat-engine was independent of the nature of the working fluid, and depended solely on the extremes of temperature in the working cylinder; or, as it has been expressed, it depends on the range of temperature of the working fluid during its working cycle. Sir William Thomson determined the exact expression for this efficiency, and it was also deduced analytically by Rankine as follows:—

$$E = \frac{T' - T^2}{T'}.$$

T' is the temperature above the absolute zero at which heat is supplied; and T^2, that at which it is rejected.

In the "Encyclopædia Britannica" (edition of 1889), article "Steam-Engine," Professor I. A. Ewing points out that in the cylinder of a gas engine the efficiency would be 87 per cent, if it were possible to expand down to atmospheric temperature and dispense with a water-jacket: thus in Centigrade temperature,

$$\frac{2173^\circ - 288^\circ}{2172^\circ} = .87 \text{ nearly.}$$

This would represent an efficiency six times greater than the most economical triple expansion steam-engine.

The conditions which are impossible in any cylinder containing a moving piston are obtainable by the Secor thermo-dynamic method. The necessity for the wasteful water-jacket at once disappears. The degree of expansion with its concomitant fall of temperature is only limited by the temperature of the sea, which constitutes the thermo-dynamic cold body or refrigerator. It may be remarked that the discharged gases, consisting principally of air, nitrogen, and carbonic acid, are poor radiators of heat, thus limiting antecedent heat-waste.

The conditions of the Secor cycle are, then, an explosion or combustion at the highest temperature—the dissociation limit—within a heated chamber, from which the outflow of heat may be prevented by suitable linings, the non-radiating products of combustion expanding in re-action against the coldest medium provided by nature (the ocean); the cooling being coincident with, and not antecedent to, the mechanical effect.

Science is to-day making demands of the steam-engine which it can never satisfy. Science says, let no heat escape from smoke-stack, or radiate from boiler, steam-pipe, or cylinder; then increase the range of temperature four or five fold that of the quadruple-expansion steam-engine. Hitherto the reply of the engineer has been, that, inasmuch as no conversion of energy can occur without some loss, even 85 or 90 per cent is, after all, not too great a tribute to pay to nature.

Thurston shows that the cannon does much better, yielding nearly 50 per cent of thermo-dynamic efficiency. The electrician working in a new field, undeterred by precedent, guided only by a knowledge of the laws which relate to the conservation and correlation of energy, has accomplished still greater results. An efficiency of 90 per cent in the dynamo is one of the grandest achievements of applied science.

Although the method of propulsion in the Secor system involves a radical change as compared with the screw, it is not impossible to estimate the efficiency of an air-jet under the circumstances indicated. The limited area of a jet of air or water has been supposed to involve a great loss of efficiency. This idea has arisen principally from erroneous conceptions in respect to the screw.

It was at one time an axiom in engineering, that the larger the exposed area of the screw, the more effective would be its action. Experience has shown the fallacy of this idea. Data of the trials of three large transatlantic steamers, showing the comparative merits of large and small screws under similar conditions, are given by Arthur I. Maginnis, Esq., in a paper read before the Institution of Naval Architects. He remarks, that "by these results it will be seen that propellers of small diameter have in each case proved the most economical and effective, both increasing the speed and decreasing coal-consumption." Mr. Isherwood has shown that decreasing the number of blades in a screw causes no falling-off in speed. Mr. Ericsson's theory was directly opposite in the early days of screw navigation. It was considered a peculiar advantage in the Ericsson screw that it had six blades. Mr. Griffiths has proved that increasing the hub area up to one-fourth the total diameter does not lessen the speed. Speaking of the tip of the blade, Mr. Barnaby says, "The tip of the blade is very little good, only you must have a tip." The exposed area need be only sufficient to absorb the engine's power: more than this is a loss.

Not only were the early engineers mistaken in regard to area, they were equally erroneous in the theory of slip. Mr. W. Froude remarks, "that to assert that a screw works with unusually little slip is to give proof that it works with a large waste of power." He remarks further, "Experiments which have been in progress since this paper has been in type show conclusively that the decrease of efficiency consequent on increasing slip, with screws of ordinary proportion, is scarcely perceptible."

In 1867 the British Government built the "Water Witch," a 1200 ton vessel, to test the value of hydraulic jet-propulsion. Engineering records show that several jet steamers have been built since that date; the latest being the "Duke of Northumberland," completed in 1890 for life-saving purposes.

It is now well known that theorists were wrong in their conceptions of the efficiency of a jet. The eminent authority, Mr. S. W. Barnaby, has shown that the efficiency of the jet is 75 per cent, as against 65 per cent for the screw: in other words, it is 15 per cent better than a remarkably efficient screw. Why, then, has not the jet entirely superseded the screw? Mr Barnaby has shown that it is due to pump inefficiency. This is a loss which may be reduced, but cannot be entirely avoided. Friction and inertia in the pump more than neutralize the enormous advantage possessed by the jet over the screw. The average pump loss is about one-half the total power.

Mr. R. H. Tucker of Boston, in 1880, tried direct-air propulsion on a canal-boat. An 8-horse-power engine drove a No. 4 Root blower, the air being discharged directly against the water astern. The Root blower has an efficiency of about 75 per cent. The result, four miles per hour, showed a good efficiency for the fuel expenditure.

As a whole, the Secor system provides those thermo-dynamic conditions which science demands, but which cannot be satisfied in a reciprocating, rotating heat-engine. In every known method of propulsion, whether paddle, screw, or jet, there is a considerable expenditure of power between the cylinder and the propeller. In the Secor system, friction and inertia of moving parts are eliminated, and, without anterior loss of heat or power, that method of propulsion is adopted which is suggested by the most advanced science.

The purpose of the present paper is to state briefly the theory of the system rather than to discuss its commercial or naval advantages. It may, however, be mentioned that a first-class transatlantic steamer carries a weight of 5,500 tons in engines, boilers, fuel, and water. To offset this permanent ballast, there is the passenger accommodation, and capacity for less than 1,000 tons of paying freight,—$10,000 in coal, about $600 in oil,—and 180 men are required to keep the leviathan in motion for one trip. In view of this situation, the advantages of the Secor system, in theory at least, are evident.

NOTES AND NEWS.

THE eighth congress of the American Ornithologists' Union will convene in Washington, D.C., on Tuesday, Nov. 18, at eleven o'clock A.M. The meetings will be held at the United States National Museum. The presentation of ornithological papers will form a prominent feature of the meetings; and members are earnestly requested to contribute, and to notify the secretary in advance as to the titles of their communications, so that a programme for each day may be prepared. The address of the secretary is John H. Sage, Portland, Conn.

— Platinum has long been recognized as an extremely refractory metal to use in electroplating, the difficulties mainly arising from the fact that the strength of the bath cannot be maintained, as with other metals, by using a plate of platinum as the anode, as the metal will not dissolve. The consequence is, that both the richness and conductivity of the bath are continually altering, and a satisfactory deposit can only be obtained by the most constant attention. In a recent paper on the subject which was read before the chemical section of the Franklin Institute, according to *Engineering* of Oct. 10, Mr. William H. Wahl states that it occurred to him that it might be possible to maintain the strength of the bath by greatly increasing the surface of platinum at the anode, which was accomplished in the following way: a plate of carbon was saturated with platinic chloride and dried, thus impregnating the plate with the salt, from which the platinum was finally reduced to the metallic state by heating the whole plate in a crucible. In this way a deposit of platinum in an extremely fine state of division was obtained in the pores of the carbon plate, and this plate was then used as the anode of the electrolytic bath. On passing the current, the platinum proved to be readily soluble in a bath of hydrochloric acid, and so far the experiment was a success; but the process proved useless from a commercial point of view, as the metal still remained insoluble when the bath consisted of oxy salts of platinum, which alone give good deposits. It was therefore necessary to devise some other plan, and after many fruitless experiments Mr. Wahl claims to have succeeded by using platinum hydroxide for maintaining the strength of the metallic solution. For this purpose the salt, which is readily soluble in alkalies and in many of the acids, may be introduced into the plating bath from time to time, and dissolved therein by stirring; or it may be permitted to remain in the bath in excess, either at the bottom or suspended in a canvas bag adjacent to or surrounding the carbon anode. A weak aqueous solution of caustic soda or caustic potash, especially the latter, will dissolve a large quantity of platinum hydrate; and the solution has the advantage of being freely conductive of electricity, and of yielding bright, regular, and adherent deposits of platinum on electrolysis. Further, with currents of moderate strength, the platinum hydrate only is affected; and hence the constitution of the bath can be easily maintained constant by adding fresh supplies of platinic hydrate. Other solvents have also been tested by Mr. Wahl, but for these details we must refer our readers to his paper, contenting ourselves with giving the main outlines of his discovery.

—The United States Coast and Geodetic Survey Office has received from the Government Printing-Office Appendices Nos. 12 and 13 to the "Report of the Superintendent for 1888," in pamphlet form. Their titles are "No. 12. Hypsometry: Heights from Geodetic Levelling between Arkansas City, on the Mississippi River, and Little Rock, Ark., 1887–88 (field-work by J. E. McGrath, sub-assistant; reduction by C. A. Schott, assistant);" "No. 13. Astronomy: Differential Method of computing Star Places," by E. D. Preston, assistant. The levelling-work in Arkansas was continued in 1889 by Sub-Assistant Isaac Winston, who ran the line from Little Rock, Ark., to Fort Smith, Ark. Mr. Winston will probably extend the same work during the coming season, beginning at Fort Smith, Ark., and running northward toward Kansas City, Mo., where eventually this line will be connected with the main transcontinental line of levels. The results that are now being obtained are immediately utilized by the Arkansas Geological Survey and others.

— A meeting of a committee of Harvard students has been held to consider the best means of raising a fund for building a new library reading-room. For several years students and instructors alike have felt the need of such a room, capable of being lighted and open in the evening. Two years ago a petition signed by nearly every student of the university was presented to the corporation, asking to have Gore Hall lighted by electricity. The corporation deemed this unsafe, since the present building is not fire proof; and impossible, since they had not the funds necessary to make it fire-proof. To a letter asking what the cost of such a reading room would be, the president replied, "A proper reading-room attached to the present library building would cost from $100,000 to $200,000, according to its size and general style. A plain stone building of sufficient size, made fire-proof and lighted with electricity, could hardly be built and furnished for less than $100,000. If the design were elaborate and handsome, as well as sufficiently spacious, it could not be built for that sum." Ill ventilation, bad light, and early closing of the library, together with the feeling that no remedy was forthcoming, brought the matter forcibly before the students. The committee above referred to considered the advisability of taking active steps in the matter, and voted to make a canvas of the college in order to raise as large a portion of the fund as possible among the students themselves, and then, by a circular letter, to appeal to the alumni for the rest. Accordingly the college has been canvassed; and, notwithstanding the many demands upon the students for money consequent upon the opening of a new college-year, 789 men have already contributed $3,530, or $4.40 per man. According to the last quinquennial catalogue, there are about 5,500 living graduates of the college proper. It is to be hoped that from so large a number at least $150,000 will be speedily forthcoming.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Fluctuations of Air-Pressure.

IT is probable that no problem in meteorology has been so puzzling as the explanation of the diurnal range of the barometer. This phenomenon is one of the most constant in meteorology; and, in fact, it is so regular near the equator, that Humboldt once said he could tell the time of day in that region by reading his barometer. On examining a barograph trace made in the tropics, we find a most surprising regularity both in the maximum and minimum points of the curve day after day, and also in the amplitude of the range. These conditions, however, do not exist in the temperate regions or in those farther north. Here there is superposed upon the diurnal range a mixed fluctuation, due in the main, if not entirely, to the passage of areas of high and low pressure. These areas are continually passing, and in consequence the diurnal range is masked, or even entirely obliterated on some days. It is known, however, that in general the diurnal range is much increased on bright, sunshiny days. Gen. Greely found a trace of this range at Fort Conger, 81° 44′ north. It is known that the range has two maximum and two minimum points. The principal maximum occurs all over the globe between 9.30 and 11 A.M., and the principal minimum from 2.30 to 4 P.M. The two other points occur approximately at the hours of the same name at night. This remarkable fluctuation is observed at the tops of high mountains, showing that the cause is above the lower atmosphere. The voyages of the "Challenger" and of other vessels have shown that this range is the same over the ocean as on the land, though the water temperature changes very slightly over the former.

It would be impossible to give in a short space all the explanations that have been advanced for this phenomenon. Changes of temperature and moisture have been appealed to in vain. A potential effect has been suggested from the fact that there may be a re-action, as it were, from the air, owing to the increasing heat in the lower strata after sunrise. It is not too much to say that any and all explanations which ascribe this change in pressure to movements of any kind in the air, to a secondary effect from changes in temperature or moisture, and to any of the forces or agencies usually appealed to in atmospheric movements, have signally and utterly broken down. In 1881 J. Allan Brown (now deceased), after thoroughly examining this question, says (*Nature*, April 14, 1881), "If we suppose that the attraction of gravity is not the only attraction which affects the pressure of the atmosphere, but that this pressure varies through some other attracting force, such as an electric attraction of the sun depending upon the varying humidity of the air, and this again depending on its temperature, we should find another method of relating the two variations, which does not exist if gravitatien alone is employed." In 1882 the present writer was called upon to give a course of twenty lectures upon meteorology before a class at Fort Myer, Va. In the nineteenth lecture of this course the remarkable similarity between the curves of diurnal range in air-pressure and of the declination magnet was pointed out, and a connection between these phenomena, as well as a common origin, were distinctly suggested (see *Annual Report of the Chief Signal Officer*, 1882, p. 142).

There has just come to hand an interesting paper on "Diurnal Variation of Terrestrial Magnetism," by Professor A. Shuster (*Philosophical Transactions of the Royal Society, London*, vol. 180, p. 509). I quote from the latter part of the paper.

"The late Professor Balfour Stewart has suggested that the earth's magnetic force might induce electric currents in the convection currents which flow in the upper regions of the atmosphere. One difficulty of this hypothesis was removed by an experimental investigation, by means of which I proved that the air can be thrown into a sensitive state in which small electro-motive forces will produce sensible electric currents. To bring the air into that sensitive state, it is only necessary to send an electric current through it from some independent source of high potential. It is very likely that the air in the upper regions of our atmosphere is in such a sensitive state; and it is quite possible, therefore, that the induced electric currents suggested by Professor Stewart really exist. In order that electric currents should be induced which could account for the observed movement of the magnetic needle, it is only necessary to imagine convection currents in the upper regions from east to west during certain parts of the day, and from west to east at other times. As regards the effect of the sun, we have, indeed, a daily period of the barometer which is probably due to thermal effects. It is curious and suggestive, that the horizontal motion which must accompany the change in pressure is just such as would account for the daily variation of the magnetic needle. In the tropics the principal minimum of the barometer takes place about 3.40 P.M., and the principal maximum about 9 A.M. According to the theory of waves, there would be a horizontal movement from west to east in the afternoon, and from east to west in the forenoon. The direction of the induced electric currents would be away from the equator in both hemispheres in the afternoon, and towards the equator in the forenoon. This is exactly the system of currents we have been led to, starting from the observed magnetic variation. The only difficulty I feel in suggesting that the cause of the diurnal variation of the magnetic needle is the diurnal variation of the barometer, lies in the fact that it would oblige us to place the electric currents into the lower regions of the atmosphere, as these only will be much affected by the thermal radiation of the sun."

I give four of Professor Shuster's conclusions.

"1. The principal part of the diurnal variation [of the needle] is due to causes outside the earth's surface, and probably to electric currents in our atmosphere.

"3. As regards the currents induced by the diurnal variation, the earth does not behave as a uniformly conducting sphere, but the upper layers must conduct less than the inner layers.

"4. The horizontal movements in the atmosphere which must accompany a tidal action of the sun or moon, or any periodic variation of the barometer such as is actually observed, would produce electric currents in the atmosphere, having magnetic effects similar in character to the observed variation.

"5. If the variation is actually produced by the suggested cause, the atmosphere must be in that sensitive state in which, according to the author's experiments, there is no lower limit to the electromotive force producing a current."

Meteorologists are now becoming somewhat accustomed to seeing suggestions from generally recognized authorities, showing the possibility of some kind of electric action taking place in the atmosphere, though I do not claim that this view is accepted as yet in any except an extremely limited sense as an explanation of atmospheric phenomena. I do not fully understand some of Professor Shuster's views. The expression "convection currents which flow" does not convey a definite meaning. Just how electric currents are to be induced in the upper air strata by a wave of heat is also not entirely plain. The expression "the horizontal motion which must accompany the change in pressure," as applied to the diurnal range of pressure, I think, simply means the horizontal propagation of a wave of pressure, and not any actual motion of air. I can hardly see how the convection currents of a thermal wave with the minimum point in the lower air strata at sunrise, and the maximum point about 3 P.M., can possibly induce electric currents having critical points at 10.30 A.M. and 3 P.M. It is generally accepted that the diurnal range of temperature in the free air is practically nothing at heights above five thousand feet; so that the supposed convection currents from the direct thermal effect cannot induce electric currents in the upper strata.

It seems to me there is also an objection to Dr. Hann's view, that the diurnal range of air-pressure can be due to the direct heat-action (*Wärmewirkung*) of the sun upon the upper limits of the atmosphere.

I have very recently discovered a method of studying the diurnal range of air-pressure and allied phenomena which seems capable of great extension, and possibly of displaying many important facts. For many years I have searched for a simple method of separating out the accidental variations of pressure, temperature, moisture, etc., in our atmosphere, produced by the progress of high and low areas, from those which are more or less constant in their action. It is quite well established that these highs and lows (called by many "anticyclones" and "cyclones") have a common progression from west to east, especially in this country. The plan proposed is to carry back the conditions observed at any moment in the atmosphere to a point of time several hours before, say twelve hours, or especially twenty-four hours. This becomes a simple matter when we have a regular advance in a high or low; for we can place its centre at the point where it was twelve or twenty-four hours previously, and then at once read off the amount of change at each station for either of those intervals of time. During the month of August, 1890, I had occasion to try this method for determining the diurnal range of air-pressure from 8 A.M. to 8 P.M., and *vice versa;* and the results were of the highest interest. For example: on Aug. 6, at 8 P.M., there was a fall in pressure in twelve hours of from one tenth to two-tenths of an inch from the Atlantic to the 107th meridian. The next morning there was almost a complete recovery over this region. On the 8th in the morning there was a rise of from one-tenth to two-tenths of an inch over the whole, and at 8 P.M. of the same day there was a fall of one tenth of an inch over half, the above region. I found the general tendency for this diurnal range in air-pressure to be the same for both highs and lows, though the fall is generally slightly greater in the low, and *vice versa* in the high. It should be noted that this diurnal range was often obliterated, or even carried in an opposite direction, in some parts of the country when it was impossible to centre exactly the two maps. There was a law, however, showing a marked general rise in pressure in the forenoon, and a corresponding fall in the afternoon. This may be seen to be all the more remarkable, since the observations were made at 8 A.M. and 8 P.M., 75th meridian time, and not at 10.30 A.M. and 3 P.M., which are the maximum and minimum points in the diurnal range. We see that these changes in air-pressure are not due to the advance of any air-wave or of air-particles, for this would imply a velocity of over two hundred miles an hour for this region alone. The rise in pressure in the forenoon cannot be due to an inflow of air from surrounding regions, because the rise occurs over all the surrounding region. It seems impossible to consider that any direct thermal effect can do more than simply heat the air without changing its pressure. It seems to me we are driven to the hypothesis that these changes are brought about by some agency outside of the earth. Is it incredible to suppose that there is a thermo-electric action from the sun upon the atmosphere propagated like a wave one thousand miles per hour, which is the principal cause of the diurnal range of both the magnetic needle and of air-pressure, and upon which other effects may be superposed?

H. A. HAZEN.

Washington, Oct. 18.

Origin of Right or Left Handedness.

THE question of the nature and origin of right or left handedness has given rise to much discussion in late years, the conviction growing among investigators that it is due to some hidden difference in the structure or function of the two hemispheres of the brain. The best *résumé* and general discussion of the question is the learned monograph by Sir Daniel Wilson entitled "The Right Hand and Left-handedness," being a reprint from the "Transactions of the Royal Society of Canada," Section II., 1886.

In order to examine more particularly into the time at which the child begins to show signs of marked preference for either hand, I instituted a series of experiments upon my own child, extending them over the greater part of the first year. As I have no time at present to write up the results systematically, I wish simply to announce a point or two which may be of interest to students of the subject.

1. I found no trace of preference for either hand as long as there were no violent muscular exertions made (based on 2,187 systematic experiments in cases of free movement of hands near the body: i.e., right hand 585 cases, left hand 568 cases, a difference of 17 cases; both hands 1,034 cases; the difference of 17 cases being too slight to have meaning).

2. Under the same conditions the tendency to use both hands together was about double the tendency to use either (seen from the number of cases of the use of both hands in the statistics given above), the period covered being from the child's sixth to her tenth month inclusive.

3. A distinct preference for the right hand in violent efforts in reaching became noticeable in the seventh and eighth months. Experiments during the eighth month on this cue gave, in 80 cases, right hand 74 cases, left hand 5 cases, both hands 1 case. In many cases the left hand followed slowly upon the lead of the right. Under the stimulus of bright colors, from 86 cases, 84 were right-hand cases, and 2 left-hand. Right-handedness had accordingly developed under pressure of muscular effort.

4. Up to this time the child had not learned to stand or to creep: hence the development of one hand more than the other is not due to differences in weight between the two longitudinal halves of the body. As she had not learned to speak or to utter articulate sounds with much distinctness, we may say also that right or left handedness may develop while the motor speech centre is not yet functioning.

Other points resulting incidentally are of interest in general psychology: i.e.,—

5. At the end of the seventh month the child's visual estimation of distance was exact enough to lead her invariably to refuse to reach for an object more than fourteen inches distant, her reaching distance being from nine to ten inches (based on tabulated experiments). Moderate stimuli she refused beyond thirteen inches.

6. Of the five colors, blue, red, green, brown, white, blue and red were most attractive, and about equally so, as measured in terms of voluntary exertion in reaching for them.

7. The fact mentioned above under Paragraph 3 furnishes another item of evidence for the presence of efferent feelings of innervation. Why did the child prefer the right hand uniformly for effort, if not under the feeling of stronger outward nervous pressure in the case of that hand? Professor James, no doubt, can explain it with his "kinaesthetic memories,"—that sword with which he decapitates so many points of evidence in his "Principles of Psychology,"—but he does not succeed in convincing many of us, any more than Bastian did in the first place. If memories of former movements with effort give "the cue," then how do you know that there are no memories of "innervation" among them? But memories of movement without effort cannot give the "cue," for my child used both hands equally in movements without effort; and the motor force of such memories would be neutral as regards hand-preference. How simple the explanation from the point of view of "innervation"! Memories of effortless movement are all of efferent sensations: hence either hand responds, or both. Memories of movements with effort are the same memories plus memory of an afferent feeling of effort: hence the right hand moves, perhaps followed by the left; that is, a memory of feeling of innervation in former cases is re-enforced by the same feeling now. Perhaps Professor James or some other "afferentist" will explain this case. The child is now (thirteenth month) a confirmed right-hander, so to speak.

I have cited only points which have their own value,—points on which observations on one child are as valuable as on many,—determinations concerning the order of development of the mental functions with the physical, not determinations merely of the time of development, which may vary. Observations on single children may also be valuable as showing that an event may happen, as opposed to theories according to which such an event may not happen, under given circumstances.

J. Mark Baldwin.

University of Toronto, Oct. 18.

Deaf-Mutes.

Professor Alexander Graham Bell, in a recent number of *Science* (Sept. 5) correctly quotes me as saying, "I do not discourage the intermarriages of the deaf, as they are usually more happily mated thus than where one of the parties only is deaf. The deaf need the companionship of married life more than those who hear, and it is a gross wrong to discourage it." And he adds the following statement and inquiry: "Dr. Gillett is probably the oldest teacher in America,—not oldest in years, but oldest in service,—and he is looked up to as a guide by very many in the profession. Much good might arise from a comparison of views between Dr. Gillett and those scientific gentlemen who have given most attention to the subject of heredity. May I ask him, through the columns of *Science*, what would he his advice in such a case as the following? A young man (not a deaf-mute) became deaf in childhood while attending public school. He has one brother who is a deaf-mute, and another who can hear. Two others of the family (believed to be hearing) died young. The father of this young man was born deaf in one ear, and lost the hearing of the other subsequently from illness. He had a congenitally deaf brother who married a congenital deaf-mute and had four children (three of them congenital deaf-mutes). The mother of the young man was a congenital deaf-mute, and she also had a brother born deaf. The paternal grandmother of the young man was a congenital deaf-mute, and she had a brother who was born deaf. This brother married a congenital deaf-mute, and had one son born deaf. The great-grandfather of this young man (father of his paternal grandmother) was a congenital deaf-mute; and he was, so far as known, the first deaf-mute in the family. Thus deafness has come down to this young man through four successive generations, and he now wants to marry a congenital deaf-mute. The young lady has seven hearing brothers and sisters, and there was no deafness in her ancestry, but she herself is believed by her family to have been born deaf. Dr. Gillett must not think that this is a purely hypothetical case, for it is not. The parties are engaged, but the marriage has not yet been consummated, and I know that Dr. Gillett's advice would have weight with the young people. The teacher of the young lady has been consulted, and she feels the responsibility deeply. Her heart is with the young couple, and she desires their happiness, and yet her judgment is opposed to the union. Will Dr. Gillett tell us what his advice would be in such a case?"

My advice in such a case as this would be for the young people to examine themselves carefully as to what their motives are in contemplating matrimony. If they have no higher thought than the animal impulse, I would advise them by no means to enter into that sacred relation; but if they are already so united in heart that each is needful to the happiness of the other, I would advise them as soon as their circumstances are such as to enable them to maintain a family in comfort, whether the children should hear or be deaf, to follow the promptings of their higher nature, with a determination to rear their children to respectability and usefulness, which they can do in one case almost as effectually as in the other. Thus one happy union will certainly be effected; while, if prevented, not only would this be estopped, but probably two unhappy, because uncongenial, ones would ensue. If deafness were a crime, or a disgrace, or entailed suffering, I would certainly discourage it; but since it does not, I deem it wise to encourage such a marriage, if the parties most interested believe, after reflection, that their own happiness will be promoted thereby.

That there are some deaf persons sprung from deaf parents is admitted, but their number is very small. There has been much discussion of late years about the advisability of deaf-mutes marrying, lest the infirmity of deafness may descend to their offspring, and a deaf variety of the human race be formed. Until a few sparrows will make spring, this hobgoblin will never materialize. Deafness is not continued by hereditary transmission in a direct line, except in rare instances. Not two per cent of the deaf and dumb are the children of deaf parents, though it cannot be denied that a susceptibility to the infirmity inheres in certain kindreds; so that we find it true, that, while a deaf pair seldom have deaf children, they have numerous other relations—as uncles; aunts; first, second, and third cousins; nephews; and nieces—who are thus afflicted. Hence, if some philanthropist is more concerned for the happiness of those who as yet are not, and may never be, than of those who now are and will for years continue with us, let him not discourage the marriage of those who are deaf, but that of their kinsmen; as, these being able to hear, and having all social advantages, the deprivation will not be so serious a matter to them as to their deaf relatives. The truth of this matter is, that, after laying all maudlin sentiment aside, there is no other class of people who so greatly need the companionship of the conjugal relation as the deaf and dumb. Shut out from church privileges, as preaching of the Word, prayer-meetings, socials, receptions, lectures, concerts, parties, what remains to them of all that makes life pleasurable to us? The deprivation of their hearing has not diminished their social instincts. For companionship, family ties, and festive associations, they have as strong affinities as any one. The isolation caused by deafness, I believe, makes the marital impulse stronger in them than in others. To forbid them, as some would, matrimony, the one remaining but most helpful and enjoyable of all social and family relations, is a monstrous cruelty with very little reason. For these reasons, after many years of observation, in which I have known hundreds of instances of deaf-mute unions, and after closely studying my more than two thousand pupils, one of my highest pleasures and satisfactions is to see them judiciously and happily mated in the conjugal relation. For the foregoing reasons I have long approved, and still do, of the marriage of the deaf; and I believe that, as a general rule, their intermarriage is more congenial, and productive of more happiness, than the marriage of deaf with hearing persons, though I have known most beautiful and happy unions of the latter kind. "Be ye not unequally yoked together," is a Scripture injunction that bears with as much force upon the deaf as upon any others. That it would be possible in process of time to generate families who would all be deaf, I fully believe.

If the object of matrimony was only to produce human animals, irrespective of their mental and spiritual nature, I should advocate the prevention of the marriage not only of the deaf, but of some other classes who labor under physical defects. But this is not the case. A true marriage is upon a higher and holier basis than this. Its essential element is in the affections of a pair whose perfect union is necessary to their happiness. The happiness of this pair I believe to be of more consequence to themselves and to society than the possible or even probable inconvenience of their offspring. I say inconvenience, for deafness is neither a crime nor a disgrace; nor does it inflict any suffering on its subject. There was a time when the deaf were considered but brutes, and classed as idiots, and treated accordingly. That time, all are thankful, is past; and in our time deaf persons often stand in society the peers of any others, in all that makes true nobility of character and manhood. In education, in mechanical skill, in æsthetic culture, in artistic talent, in true refinement and taste, they are oftentimes above the average of hearing people; and sometimes the deaf member of the family is the one of all his kindred most entitled to respect, because his deafness, having withdrawn him from his surroundings, has placed within his reach an education and culture that enables him to live on a much higher plane than any of his relations enjoy, and than he would have enjoyed if he had not been deaf. There is in society a vast amount of practical ignorance concerning the deaf, which it seems almost impossible to eradicate. This is one of the heritages handed down from former times, when deafness was indeed a great calamity, consigning its subject to perpetual infancy in law, and to dense ignorance for life. But, as already stated, times have changed; and what was once a calamity is now only a serious inconvenience. There are other inconveniences that descend by heredity that we might quite as well combat through matrimony as deafness. Baldness is a physical defect that is often (in fly-time and in cold weather, or when sitting in a draught, for instance) a great inconvenience; but who ever thought of classing the bald-headed among the defective classes, or of regarding baldness as a crime or disgrace? Near-sightedness is a physical defect that is often very inconvenient; but who ever thought to trace the pedigree of bald or near-sighted people, to see if they might enter into wedlock? PHILIP G. GILLETT.

Jacksonville, Ill., Oct. 22.

Chalk from the Niobrara Cretaceous of Kansas.

THE chalk from the Niobrara cretaceous of Kansas has long been known, but, so far as I am aware, little has been hitherto discovered regarding its structure or formation. Professor Patrick, some years ago, stated that it contained no microscopic organisms, but afterwards, with the aid of a very high power objective, found what he thought were organic remains. This is all the more remarkable, as the chalk appears to be wholly composed of organic forms, very readily visible under a comparatively low power (a one-fifth or a one-sixth objective and a C eye-piece). A ready way to detect them is by allowing a thin film held in suspension in water to dry on a slide, afterward mounting in balsam. I have examined a number of specimens, and find the material composed of small elliptical disks, either with four depressions or foramina, leaving ridges in the shape of a Greek cross, or with one or two central depressions or nuclei. Scattered among them are small slender rods, and occasionally a number of these were seen attached to a central mass. I believe the disks to be coccoliths (discoliths), which occur abundantly in the white chalk of England, and, at the present day, in deep-sea deposits. The Kansas chalk, however, has always been thought to be a shallow-sea deposit,—a belief strengthened by the abundance of thick-shelled molluscan remains, such as certain *Inocerami*, *Rudistes*, etc. The Kansas chalk, unlike the English, shows no flinty nodules. I shall make further examinations of material from different regions of the outcrop, which varies not a little in its physical and fossiliferous characters, and publish further results of my investigations, with figures. S. W. WILLISTON.

University of Kansas, Oct. 24.

AMONG THE PUBLISHERS.

THE Forest and Stream Publishing Company of New York will issue at once the first number of a quarterly publication entitled "The Book of the Game-Laws," compiled by the editor of *Forest and Stream*, and containing all the laws of the United States and Canada relating to game and fish.

—Messrs. John Wiley & Sons announce for immediate publication Egleston's "Metallurgy," Vol. II.

—D. C. Heath & Co. have in active preparation for early publication "The American Citizen," by Rev. Charles F. Dole. It is intended to provide a book suitable for the higher grades of the grammar-school, as well as for high-schools and academies.

—The Goldthwaite Geographical Exchange, New York, has brought out a new edition, based on the 1890 census, of "Cram's Standard American Atlas." Special attention is given in this atlas to the railway systems, which are printed in separate colors. The index is claimed to be very complete, giving not only the location of the places, but also the means of reaching them by rail, express, etc., and the banking facilities available.

—Messrs. D. C. Heath & Co., Boston, have in preparation the following additions to their valuable list of works on education: (1) the authorized translation of Compayré's "Psychologie Appliquée à l'Education," in two volumes,—Vol. I., "Notions Théoretiques," a treatise on elementary psychology; Vol. II., "Application," a practical application of the principles of psychology to physical, intellectual, and moral education; and (2) the authorized translation of Compayré's "Cours de Morale Théoretique et Pratique." These lectures are all fully indexed, and each is followed by a *résumé* of its contents.

—Three new Old South Leaflets have been added to the general series published by D. C. Heath & Co., all of them devoted to Indian subjects. The first is Coronado's "Letter to Mendoza in 1540," written probably from the Zuñi peublo, describing his search through New Mexico for the famous "Seven Cities of Cibola." This English translation of Coronado's report has never been published before except in the large and costly collection of Hakluyt; and it is of special interest at this time, when the researches of Frank Cushing and others have directed attention anew to the Zuñi country. The other two leaflets are John Eliot's "Brief Narrative of the Progress of the Gospel Amongst the Indians of New England," first printed in London in 1671, and Rev. Eleazer Wheelock's "Narrative of the Original Design, Rise, Progress, and Present State of the Indian Charity-School in Lebanon, Conn." (1762). The establishment of this school was the most important and interesting effort for the education of the Indians in New England, in the last century; Dartmouth College, of which Wheelock was the first president, being an outgrowth of the school. These papers are a valuable addition to the series of Old South Leaflets, which now furnishes so many original historical documents to our students at the cost of a few cents, Wheelock's "Narrative" being No. 22 of the series Mr. Mead's historical and bibliographical notes to the three new leaflets are full.

—The result of the experiments at the Ohio State Agricultural Station in the cultivation of different varieties of strawberries shows that if we separate varieties of strawberries into two classes, —viz., those that continue a long time in bearing, and those that have a short season,—we find that the most prolific fall into the first class, while those that give small crops continue but a short time in bearing: in other words, those that give the greatest number of pickings during the season produce the largest crops. It might seem that the aggregate crop would depend as much, or more, upon the quantity of fruit ripe at each picking, as upon the number of pickings; it would also seem that the varieties that ripen slowly, and continue a long time in bearing, would be more in danger of dry weather than those that yield their crop in a short time: but such does not appear to be the fact. Nearly all of the very early varieties continue but a short time in bearing, yield but few pickings, and give short crops. The same is true, in a more marked degree, of the extreme late sorts. They commence to ripen late, but hold out little, if any, longer than the medium varieties. The second early or medium varieties usually give more

pickings during the season, and continue longer in bearing, than the extreme early and late sorts, hence give a greater total yield. Those varieties of strawberries that produce pollen and berries also, are at a disadvantage as compared with those that produce berries only. Division of labor counts here as elsewhere. Give a plant nothing to do but to grow and bear fruit, and the work will be better done than if an additional task is imposed. To produce pollen taxes the energies of the plant much more than is commonly supposed. Many growers think it would be desirable to have varieties with perfect blossoms only to save the trouble of planting the two classes. Theory disproves this plan; and careful observations show, that, in general, the most prolific sorts are those that have imperfect flowers. It should be understood that these statements refer to the leading varieties that are most generally grown. There are some apparent exceptions even with these, and still more if all known varieties are included.

—The November number of *The Sanitarian*, forthcoming, will begin the publication of the "Transactions of the American Climatological Association," held at Denver, Col., Sept. 2, 3, and 4, 1890. All new subscribers for *The Sanitarium* for 1891, sending their subscriptions before the 15th of November, will be supplied with the November and December numbers gratis. All correspondence should be addressed to the editor, A. N. Bell, M.D., 113a Second Place, Brooklyn, N.Y.

—Mr. Edward L. Wilson, who has travelled extensively through the Holy Land with notebook and camera, is about to publish the results of his wanderings in a work entitled "In Scripture Lands." It is to be issued at an early date by the Scribners. A new work of practical value, entitled "Electricity in Daily Life," is also about to be published by them. It is a popular account of the application of electricity to every-day uses. The various branches of the work have been intrusted to writers selected for their expert acquaintance with the subject. A life of John Ericsson will be published immediately by the same firm. It is written by Col. Church, who was intimately acquainted with Ericsson for many years, and has been intrusted with the famous inventor's papers and correspondence. It will be profusely illustrated. They have already issued new and cheaper editions of Schuyler's "Peter the Great" and Professor Shaler's "Aspects of the Earth."

— *Public Opinion*, the eclectic weekly published in Washington and New York, offers a first prize of $50, a second of $30, and a third of $20, for the best three essays on the interesting question "The Industrial Future of the South." The essays must be limited to 3,000 words, and must be received by Dec. 15. Full particulars may be had by addressing *Public Opinion*, Washington, D.C.

— The *Nineteenth Century* for October opens with a symposium on "The Labor Revolution," by H. H. Champion, T. R. Threlfall, and Hon. R. B. Brett. Mr. Champion's paper is entitled "A Multitude of Counsellors;" Mr. Threlfall, who is secretary to the Labor Electoral Association of Great Britain and Ireland, discusses the new departures in trades-unionism; and Mr. Brett raises the question as to what are the ideals of the masses. His Excellency Sir Henry A. Blake, governor of Jamaica, contributes a paper on "The Awakening of Jamaica," in which he discusses the past and present economical history of the island, and the latest attempts to revive its resources; D. Henry Behrends points out the dangers of tuberculous meat and its consequences; Wilfrid Ward gently and sympathetically touches on some aspects of Newman's influence; Hamilton Aide describes manners and customs in Sicily in 1890; the Bishop of Carlisle writes on "Bees and Darwinism," and defends himself against an attack of Professor Romanes; Arthur P. Crouch discusses the relations between Dahomey and the French; Miss Benson comes to the defence of domestic service; B. Paul Neuman and the Rev. Herbert Darlow examine the weaknesses of Congregationalism, the former from the pews, the latter

from the pulpit; J. Aratoon Malcolm presents a plea for Armenia in a paper entitled "Armenians' Cry for Armenia;" Louis J. Jennings describes the imperfections in the English civil service as illustrated in the admiralty; and the number closes with an article on "Meddling with Hindoo Marriages," by J. D. Roos.

— The recent death of Canon Liddon will furnish the theme of many an article *in memoriam*, and the *Reviews* are already printing tributes to the memory of the great English preacher. Canon Scott Holland opens the *Contemporary Review* for October with a brief but sympathetic notice of the life and work of his friend; Sir Morell Mackenzie writes at some length on "The Use and Abuse of Hospitals," and makes many suggestions that are of value; Sir Dr. William Wright takes up the forward movement in China, giving his attention to the progress of missions and the conditions they have to contend with; Sir T. H. Farrer discusses imperial finance of the last four years in the first of a series of papers on recent English financial methods; A. Taylor Innes writes on "Standpoint of the English Law;" Michael G. Mulhall points out the possibilities of naval warfare; Mr. Justice O'Hagan tells the story of the life of Thomas Davis as an illustration of Irish patriotism; and Dr. F. H. Geffcken contributes a thoughtful paper on "The Economic Condition of Italy." The more strictly literary portion of the number is to be found in the first part of a story by Vernon Lee, entitled "A Worldly Woman."

— "The Problems of Greater Britain," based on Sir Charles Dilke's famous work, forms the opening paper in the *Westminster Review* for October; Ernest A. Vizetelly concludes his papers on Paoli the Patriot; Jeannie Lockett makes a valuable contribution to the divorce question in an article on "Clerical Opposition to Divorce in Australia;" T. W. Rolleston tells the story of the Irish Parliament and its struggle for reform in 1782–93; Frances Russell contributes a brief and suggestive paper on "Neglected Path to Greatness;" Mr. George C. Call describes the search for the lost Mr. Bathurst, whose disappearance in the early part of the century has never been accounted for; Alice Bodington writes on "The Importance of Race end its Bearing on the Negro Question;" and the number concludes with the usual review of the English politics, and the department of "Contemporary Literature," reviews of the latest books,—a feature of the *Westminster* which has just been revived, and which was once its strongest part.

—A new and revised edition of Jesse R. Macy's work on "Our Government" has appeared from the press of Ginn & Co. It has always been deemed one of the best works of the kind, and the author has endeavored to improve on the original edition in accordance with the lessons of experience. Mr. Macy's style of expression has no great literary finish, but is plain and easily intelligible. The work is very condensed, and the student cannot read it in a hurry; but this condensation enables it to convey a great deal of information in a small space. It treats the whole subject of governmental agencies, national, state, and municipal—treats it, for the most part, well. One of the best parts of the book relates to the administration of justice,—a subject that is apt to be neglected in such works, but which is more important than any other. Mr. Macy has given his chief attention to description, and yet a good deal of information as to the purpose and uses of government is incidentally conveyed. The book deserves its reputation, and we hope will continue to be widely used.

—The October number of the *Fortnightly Review* contains the first parts of two new novels,—one by Count Leo Tolstoi, entitled "Work while You have Light," a tale of the early Christians; the other by George Meredith, entitled "One of Our Conquerors." Both these novels are highly characteristic of their authors, and are destined to attract wide attention. The general articles of the *Review* suffer no diminution through the introduction of the new element and its development from the standpoint of a resident. The series of papers on "Modern Russia," by E. B. Lanin,

which have been an important feature of the *Fortnightly* for some months past, approach a conclusion in an article on "Jews in Russia." Sir Frederick Pollock writes on John Milton; Miss M. Dewie contributes a readable paper entitled "In Ruthenia," dealing with a province of Poland that is almost unknown to the general tourist, but which possesses many points of interest; A. Egmont Hake and O. E. Wesslau discuss the American tariff war; there is a suggestive paper on "Reason and Religion;" A. Symons Eccles criticises the results of the Tenth International Medical Congress; George Moore criticises the new pictures in the National Gallery; and George Saintsbury sketches the life and works of Anthony Hamilton.

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

Oct. 25.—William Harkness, On the Determination of the Mass of the Moon from the Tides; F. H. Bigelow, Some Suggestions on Eclipse Photography and Eclipse Apparatus.

Natural Science Association of Staten Island.

Oct. 9.—William T. Davis, The Yellow-Winged Sparrow (*Ammodromus passerinus*) and a Black and White Creeper (*Mniotilta varia*). The following objects, presented by Mr. William Olliff, were shown: fragments of a large decorated Indian pot, two celts or skin-scrapers, and several examples of concretions, all from Tottenville and vicinity. A stone axe, found while digging a trench for gas-pipe on Richmond Avenue, Clifton, was presented by Mr. James W. Allen. Mr. Thomas Craig showed plants of *Lemna trisulca*, an addition to the flora of the island, found in streams in the Clove Valley; also *Azolla Caroliniana* from the same locality, where it has evidently become thoroughly established since its introduction there by Mr. Samuel Henshaw in 1885.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—A situation as Analytical Chemist is desired by the assistant of the late noted scientist, D. Cook, during his 15 years survey of the State of New Jersey. Highest testimonials furnished. Address Prof. EDWIN H. BOGARDUS, New Brunswick, P. O. Box 224, care Prof. F. C. Van Dyck.

WANTED.—To purchase a complete set, or single numbers, of Loomis' contributions to meteorology, published in the *American Journal of Science*. Address communication, stating price, to FRANK WALDO, Mountain Lake Park, Garrett Co., Maryland.

COULD some one inform me what the ingredients and origin of asphalt as used for street-paving and gathered at Trinidad are? Also how gathered and shipped by natives, and mode of refining by the Warren-Scharf Co. of New York and the Barber Co. of Washington? G. KNIPER, 28 Gunn Block, Grand Rapids, Mich.

WANTED.—A position in a Normal School or College as teacher of Botany, Physiology, Zoölogy, Embryology, Chemistry, Physics, or German, by a university graduate who has done special work in the above lines. Several years' experience in teaching, and one year as assistant in Biology in a prominent university. Box 396, Greencastle, Ind.

PROFESSOR W. M. DAVIS, Harvard College, Cambridge, Mass., desires to correspond with professional and amateur photographers, from whom he can obtain views of New England landscapes.

Exchanges.

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To exchange, 1890 Seeger and Guernsey Cyclopedia, containing a complete list of the manufactures and products of the U. S., and address of first hands, cost $6. David R. Lewis, Saybrook, Ill.

For exchange—Nice specimens of Unios alatus, trigonus, parvus, occidens, anadontoides gibbosus, rectus, verucosus, gracilis coccineus, ventricasus, multiplicatus and plicatus cornutus. Margaritana confrogosa, complanata, rugosa. Anadonta edentula, decora, corpulenta, and about 300 of the beautiful Ana. suborbiculata. Wanted: Unios from all parts of the world, and sea-shells. Address Dr. W. S. Strode, Bernadotte, Ill.

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SCIENCE

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A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

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ANTARCTIC EXPLORATION.[1]

MY experience during the four years which have elapsed since this project was first mooted in Melbourne, is that any reference to the subject is sure to be met with the query *Cui bono?* What good can it do? What benefit can come from it? What is the object to be served by such an expedition?

In setting myself to the task of answering these questions, let me observe that it would indeed be strange if an unexplored region eight million square miles in area,—twice the size of Europe,—and grouped around the axis of rotation and the magnetic pole, could fail to yield to investigators some novel and valuable information. But when we notice that the circle is engirdled without by peculiar physical conditions which must be correlated to special physical conditions within, speculation is exchanged for a confident belief that an adequate reward must await the skilled explorer. The expected additions to the geography of the region are, of all the knowledge that is to be sought for there, the least valuable. Where so many of the physical features of the country—the hills, the valleys, and the drainage lines—have been buried beneath the snow of ages, a naked outline, a bare skeleton of a map, is the utmost that can be delineated. Still, even such knowledge as this has a distinct value, and, as it can be acquired by the explorers as they proceed about their more important researches, its relatively small value ought not to be admitted as a complete objection to any enterprise which has other objects of importance. Our present acquaintance with the geography of the region is excessively limited. Ross just viewed the coast of Victoria Land, between 163° east and 160° west longitude. He trod its barren strand twice, but on each occasion for a few minutes only. From the adjacent gulf he measured the heights of its volcanoes, and from its offing he sketched the walls of its icy barrier. Wilkes traced on our map a shore-line from 97° to 167° east longitude, and he backed it up with a range of mountains, but he landed nowhere. Subsequently Ross sailed over the site assigned to part of this land, and hove his lead 600 fathoms deep where Wilkes had drawn a mountain. He tells us that the weather was so very clear, that, had high land been within 70 miles of that position, he must have seen it (*Ross's Voyage*, 1278). More recently Nares, in the "Challenger," tested another part of Wilkes's coast-line, and with a like result; and these circumstances throw doubts upon the value of his reported discoveries. D'Urville subsequently followed a bold shore for a distance of about 300 miles from 136° to 142° east longitude, while in 67° south latitude, and between 45° and 60° east longitude are Enderby's and Kemp's lands. Again, there is land to the south of the Horn, which trends from 45° to 75° south latitude. These few discontinuous coast-lines comprise all our scanty knowledge of the Antarctic land. It will be seen from these facts that the principal geographical problem awaiting solution is the interconnection of these scattered shores. The question is, do they constitute parts of a continent, or are they, like the coasts of Greenland, portions of an archipelago, smothered under an overload of frozen snow, which conceals their insularity? Ross inclined to the latter view, and he believed that a wide channel leading towards the pole existed between North Cape and the Balleny Islands (*Ross's Voyage*, 1221). This view was also held by the late Sir Wyville Thompson. A series of careful observations upon the local currents might throw some light upon these questions. Ross notes several such in his log. Off Possession Island a current, running southward, took the ships to windward (*Ross's Voyage*, 1195). Off Coulman Island another drifted them in the same direction at the rate of 18 miles a day (*Ross's Voyage*, 1204). A three-quarter knot northerly current was felt off the Barrier, and may have issued from beneath some part of it. Such isolated observations are of little value, but they were multiplied; and were the currents correlated with the winds experienced, the information thus obtained might enable us to detect the existence of straits, even where the channels themselves are masked by ice-barriers.

Finally it is calculated that the centre of the polar ice-cap must be three miles, and may be twelve miles, deep, and that, the material of this ice mountain being viscous, its base must spread out under the crushing pressure of the weight of its centre. The extrusive movement thus set up is supposed to thrust the ice cliffs off the land at the rate of a quarter of a mile per annum. These are some of the geographical questions which await settlement.

In the geology of this region we have another subject replete with interest. The lofty volcanoes of Victoria Land must present peculiar features. Nowhere else do fire and frost divide the sway so completely. Ross saw Erebus belching out lava and ashes over the snow and ice which coated its flanks. This circumstance leads us to speculate on the strata that would result from the alternate fall of snow and ashes during long periods and under a low temperature. Volcanoes are built up, as contradistinguished from other mountains, which result from elevation or erosion. They consist of *débris* piled round a vent. Lava and ashes surround the crater in alternate layers. But in

[1] Address delivered at the annual meeting of the Bankers' Institute of Australasia, Aug. 27, 1890, by G. S. Griffiths.

this polar region the snowfall must be taken into account as well as the ash deposit and the lava-flow. It may be thought that any volcanic ejecta would speedily melt the snow upon which they fell, but this does not by any means necessarily follow. Volcanic ash, the most widespread and most abundant material ejected, falls comparatively cold, cakes, and then forms one of the most effective non-conductors known. When such a layer, a few inches thick, is spread over snow, even molten lava may flow over it without melting the snow beneath. This may seem to be incredible, but it has been observed to occur. In 1828, Lyell saw on the flanks of Etna a glacier sealed up under a crust of lava. Now, the Antarctic is the region of thick-ribbed ice. All exposed surfaces are quickly covered with snow. Snow-falls, ash-falls, and lava-flows must have been heaping themselves up around the craters during unknown ages. What has been the result? Has the viscosity of the ice been modified by the intercalation of beds of rigid lava and of hard-set ash? Does the growing mass tend to pile up, or to settle down and spread out? Is the ice wasted by evaporation, or does the ash-layer preserve it against this mode of dissipation? These interesting questions can be studied round the south pole, and perhaps nowhere else so well.

Another question of interest, as bearing upon the location of the great Antarctic continent, which it is now certain existed in the secondary period of geologists, is the nature of the rocks upon which the lowest of these lava-beds rest. If they can be discovered, and if they then be found to be sedimentary rocks such as slates and sandstones, or Plutonic rocks such as granite, they will at once afford us some data to go upon, for the surface exposure of granite signifies that the locality has been part of a continental land sufficiently long for the weathering and removal of the many thousands of feet of sedimentary rocks which of necessity overlie crystalline rocks during their genesis; while the presence of sedimentary rocks implies the some-time proximity of a continent, from the surfaces of which alone these sediments, as rainwash, could have been derived.

As ancient slate rocks have already been discovered in the ice-clad South Georgias, and as the drag-nets of the "Erebus" and the "Challenger" have brought up from the beds of these icy seas fragments of sandstones, slates, and granite, as well as the typical blue mud which invariably fringes continental land, there is every reason to expect that such strata will be found.

Wherever the state of the snow will permit, the polar mountains should be searched for basaltic dikes, in the hope that masses of specular iron and nickel might be found similar to those discovered by Nordenskiöld at Ovifak, in North Greenland. The interest taken in these metallic masses arises from the fact that they alone, of all the rocks of the earth, resemble those masses of extra-terrestrial origin which we know as meteorites. Such bodies of unoxidized metal are unknown elsewhere in the mass, and why they are peculiar to the Arctic it is hard to say. Should similar masses be found within the Antarctic, a fresh stimulus would be given to speculation. Geologists would have to consider whether the oxidized strata of the earth's crust thin out at the poles; whether in such a case the thinning is due to severe local erosion, or to the protection against oxygen afforded to the surface of the polar regions by their ice-caps; or to what other cause. Such discoveries would add something to our knowledge of the materials of the interior of our globe and their relation to those of meteorites.

Still looking for fresh knowledge in the same direction, a series of pendulum observations should be taken at points as near as possible to the pole. Within the Arctic Circle the pendulum makes about 240 more vibrations per day than it does at the equator. The vibrations increase in number there, because the force of gravity at the earth's surface is more intense in that area; and this, again, is believed to be due to the oblateness of that part of the earth's figure, but it might be caused by the bodily approach to the surface at the poles of the masses of dense ultra-basic rocks just referred to. Thus, pendulum experiments may reveal to us the earth's figure; and a series of such observations recorded, from such a vast and untried area, must yield important data for the physicist to work up. We should probably learn from such investigations whether the earth's figure is as much flattened at the Antarctic as it is known to be at the Arctic.

We now know that in the past the north-polar regions have enjoyed a temperate climate more than once. Abundant seams of paleozoic coal, large deposits of fossiliferous jurassic rocks, and extensive eocene beds, containing the remains of evergreen and deciduous trees and flowering plants, occur far within the Arctic Circle. This circumstance leads us to wonder whether the corresponding southern latitudes have ever experienced similar climatic vicissitudes. Conclusive evidence on this point it is difficult to get; but competent biologists who have examined the floras and faunas of South Africa and Australia, of New Zealand, South America, and the isolated islets of the Southern Ocean, find features which absolutely involve the existence of an extensive Antarctic land,—a land which must have been clothed with a varied vegetation, and have been alive with beasts, birds, and insects. As it also had had its fresh-water fishes, it must have had its rivers flowing and not frost-bound, and in those circumstances we again see indications of a modified Antarctic climate. Let us briefly consider some of the evidence for the existence of this continent. We are told by Professor Hutton of Christchurch that 44 per cent of the New Zealand flora is of Antarctic origin. The Auckland, Campbell, and Macquarie Islands all support Antarctic plants, some of which appear never to have reached New Zealand. New Zealand and South America have three flowering plants in common, also two fresh-water fishes, five seaweeds, three marine crustaceans, one marine mollusk, and one marine fish. Similarly New Zealand and Africa have certain common forms; and the floras and faunas of the Kerguelen, the Crozets, and the Marion Islands are almost identical, although in each case the islands are very small and very isolated from each other and from the rest of the world. Tristan d'Acunha has 58 species of marine *Mollusca*, of which number 13 are also found in South America, six or seven in New Zealand, and four in South Africa (Hutton's *Origin of New Zealand Flora and Fauna*). Temperate South America has 74 genera of plants in common with New Zealand, and 11 of its species are identical (Wallace's *Island Life*). Penguins of the genus *Eudyptes* are common to South America and Australia (Wallace's *Dist. of Animals*, 1399). Three groups of fresh-water fishes are entirely con-

fined to these two regions. *Aphritis*, a fresh-water genus, has one species in Tasmania, and two in Patagonia. Another small group of fishes known as the *Haplochitonidæ* inhabit Tierra del Fuegia, the Falklands, and South Australia, and are not found elsewhere; while the genus *Galaxias* is confined to south temperate America, New Zealand, and Australia. Yet the lands which have these plants and animals in common are so widely separated from each other that they could not now possibly interchange their inhabitants. Certainly towards the equator they approach each other rather more; but even this fact fails to account for the present distribution, for, as Wallace has pointed out, "the heat-loving *Reptilia* afford hardly any indications of close affinity between the two regions" of South America and Australia, "while the cold-enduring *Amphibia* and fresh-water fishes offer them in abundance" (Wallace, *Dist. of Animals*, 1400). Thus we see that to the north interchange is prohibited by tropical heat, while it is barred to the south by a nearly shoreless circumpolar sea. Yet there must have been some means of intercommunication in the past, and it appears certain that it took the shape of a common fatherland for the various common forms from which they spread to the northern hemisphere. As this fatherland must have been accessible from all these scattered southern lands, its size and its disposition must have been such as would serve the emigrants either as a bridge or as a series of stepping-stones. It must have been either a continent or an archipelago.

But a further and a peculiar interest attaches to this lost continent. Those who have any acquaintance with geology know that the placental *Mammalia*—that is, animals which are classed with such higher forms of life as apes, cats, dogs, bears, horses, and oxen—appear very abruptly with the incoming of the tertiary period. Now, judging by analogy, it is not likely that these creatures can have been developed out of mesozoic forms with any thing like the suddenness of their apparent entrance upon the scene. For such changes they must have acquired a long time, and an extensive region of the earth; and it is probable that each of them had a lengthy series of progenitors, which ultimately linked it back to lower forms.

Why, then, it is constantly asked, if this was the sequence of creation, do these missing links never turn up? In reply to this query, it was suggested by Huxley that they may have been developed in some lost continent, the boundaries of which were gradually shifted by the slow elevation of the sea-margin on one side and its simultaneous slow depression upon the other; so that there has always been in existence a large dry area with its live-stock. This dry spot, with its fauna and flora, like a great raft or Noah's Ark, moved with great slowness in whatever direction the great earth undulation travelled. But to-day this area, with its fossil evidences, is a sea-bottom; and Huxley supposes that the continent, which once occupied a part of the Pacific Ocean, is now represented by Asia.

This movement of land-surface translation eastwards eventually created a connection between this land and Africa and Europe; and if, when this happened, the *Mammalia* spread rapidly over these countries, this circumstance would account for the abruptness of their appearance there.

Now, Mr. Blandford, the president of the Geological Society of London, in his annual address recently delivered, advances matters a stage further; for he tells us that a growing acquaintance with the biology of the world leads naturalists to a belief that the placental *Mammalia*, and other of the higher forms of terrestrial life, originated during the mesozoic period—still further to the southwards, that is to say—in the lost Antarctic continent, for the traces of which we desire to seek.

But it almost necessarily follows, that, wherever the *Mammalia* were developed, there also man had his birthplace; and, if these speculations should prove to have been well founded, we may have to shift the location of the Garden of Eden from the northern to the southern hemisphere.

I need hardly suggest to you that possibilities such as these must add greatly to our interest in the recovery of any traces of this mysterious region. This land appears to have sunk beneath the seas after the close of the mesozoic. Now, the submergence of any mass of land will disturb the climatic equilibrium of that region, and the disappearance of an Antarctic continent would prove extremely potential in varying the climate of this hemisphere; for to-day the sun's rays fall on the south-polar regions to small purpose. The unstable sea absorbs the heat, and in wide and comparatively warm streams it carries off the caloric to the northern hemisphere, to raise its temperature at the expense of ours. But when extensive land received those same heat-rays, its rigid surfaces, so to speak, tethered their caloric in this hemisphere; and thus, when there was no mobile current to steal northwards with it, warmth could accumulate, and modify the climate.

Under the influences of such changes, the icy mantle would be slowly rolled back towards the south pole, and thus many plants and animals were able to live and multiply in latitudes that to-day are barren. What has undoubtedly occurred in the extreme north is equally possible in the extreme south. But if it did occur,—if south-polar lands, now ice-bound, were then as prolific of life as Disco and Spitzbergen once were,—then, like Spitzbergen and Disco, the unsubmerged remnants of this continent may still retain organic evidences of the fact in the shape of fossil-bearing beds, and the discovery of such deposits would confirm or confute such speculations as these. The key to the geological problem lies within the Antarctic Circle, and to find it would be to recover some of the past history of the southern hemisphere. There is no reason to despair of discovering such evidence, as Dr. M'Cormack, in his account of Ross's voyage, records that portions of Victoria Land were free from snow, and therefore available for investigation, besides which their surface may still support some living forms, for they cannot be colder or bleaker than the peaks which rise out of the continental ice of North Greenland; and these, long held to be sterile, have recently disclosed the existence upon them of a rich though humble flora.

We have now to consider some important meteorological questions. If we look at the distribution of the atmosphere around the globe, we shall see that it is spread unequally. It forms a stratum which is deeper within the tropics than about the poles, and over the northern than over the southern hemisphere, so that the barometer normals fall more as we approach the Antarctic than they do when we near the Arctic. Maury, taking the known isobars as his guide, has calculated that the mean pressure at the north pole is 29.1,

but that it is only 28 at the south (Maury's *Meteorology*, p. 259). In other words, the Antarctic Circle is permanently much barer of atmosphere than any other part of the globe. Again, if we consult a wind-chart, we shall see that both poles are marked as calm areas. Each is the dead centre of a perpetual wind-vortex, but the south-polar indraught is the stronger. Polarward winds blow across the 45th degree of north latitude for 189 days in the year, but across the 45th degree of south latitude for 209 days. And while they are drawn in to the north pole from over a disk-shaped area 5,500 miles in diameter, the south-polar indraught is felt throughout an area 7,000 miles across. Lastly, the winds which circulate about the south pole are more heavily charged with moisture than are the winds of corresponding parts of the other hemisphere. Now, the extreme degree in which these three conditions—of a perpetual grand cyclone, a moist atmosphere, and a low barometer—co-operate without the Antarctic, ought to produce within it an exceptional meteorological state; and the point to be determined is, what that condition may be. Maury maintained that the conjunction will make the climate of the south-polar area milder than that of the north. His theory is, that the saturated winds, being drawn up to great heights within the Antarctic, must then be eased of their moisture, and that simultaneously they must disengage vast quantities of latent heat; and it is because more heat must be liberated in this manner in the south-polar regions than in the north, that he infers a less severe climate for the Antarctic. He estimates that the resultant relative differences between the two polar climates will be greater than that between a Canadian and an English winter (Maury's *Meteorology*, p. 466). Ross reports that the south-polar summer is rather colder than that of the north, but still the southern winter may be less extreme, and so the mean temperature may be higher. If we examine the weather reports logged by Antarctic voyagers, instead of the temperature merely, the advantage still seems to rest with the south. In the first place, when the voyager enters the Antarctic, he sails out of a tempestuous zone into one of calms. To demonstrate the truth of this statement, I have made an abstract of Ross's log for the two months of January and February, 1841, which he spent within the Antarctic Circle. To enable every one to understand it, it may be well to explain that the wind-force is registered in figures from 0, which stands for a dead calm, up to 12, which represents a hurricane. I find that during these 60 days it never once blew with the force 8; that is, a fresh gale. Only twice did it blow force 7, and then only for half a day each time. Force 5 to 6—fresh to strong breezes—is logged on 21 days. Force 1 to 3—that is, gentle breezes—prevailed on 34 days. The mean wind-force registered under the entire 60 days was 3.43; that is, only a four to five knot breeze. On 38 days blue sky was logged. They never had a single fog, and on 11 days only was it even misty. On the other hand, snow fell almost every second day. We find such entries as these: "Beautifully clear weather," and "Atmosphere so extraordinarily clear that Mount Herschel, distant 90 miles, looked only 30 miles distant." And again, "Land seen 120 miles distant, sky beautifully clear." Nor was this season exceptional, so far as we can tell; for Dr. M'Cormack, of the "Erebus," in the third year of the voyage, and after they had left the Antarctic for the third and last time, enters in his diary the following remark. He says, "It is a curious thing that we have always met with the finest weather within the Antarctic Circle; clear, cloudless sky, bright sun, light wind, and a long swell" (M'Cormack's *Antarctic Voyage*, v. i. p. 345). It would seem as if the stormy westerlies, so familiar to all Australian visitors, had given to the whole southern hemisphere a name for bad weather, which as yet, at least, has not been earned by the south-polar regions. It is probable, too, that the almost continuous gloom and fog of the Arctic (Scoresby's *Arctic Regions*, pp. 97 and 137) in July and August have prejudiced seamen against the Antarctic summer. The true character of the climate of this region is one of the problems awaiting solution. Whatever its nature may be, the area is so large and so near to us, that its meteorology must have a dominant influence on the climate of Australia; and on this fact the value of a knowledge of the weather of these parts must rest.

To turn to another branch of science, there are several questions relating to the earth's magnetism which require for their solution long-maintained and continuous observations within the Antarctic Circle. The mean or permanent distribution of the world's magnetism is believed to depend upon causes acting in the interior of the earth, while the periodic variations of the needle probably arise from the superficial and subordinate currents produced by the daily and yearly variations in the temperature of the earth's surface. Other variations occur at irregular intervals, and these are supposed to be due to atmospheric electricity. All these different currents are excessively frequent and powerful about the poles; and a sufficient series of observations might enable physicists to differentiate the various kinds of currents, and to trace them to their several sources, whether internal, superficial, or meteoric. To do this properly, at least one land observatory should be established for a period. In it the variation, dip, and intensity of the magnetic currents, as well as the momentary fluctuations of these elements, would all be recorded. Fixed term days would be agreed on with the observatories of Australia, of the Cape, America, and Europe; and during these terms a concerted continuous watch would be kept up all round the globe to determine which vibrations were local, and which general.

The present exact position of the principal south magnetic pole has also to be fixed, and data to be obtained from which to calculate the rate of changes, in the future; and the same may be said of the foci of magnetic intensity and their movements. In relation to this part of the subject, Capt. Craik recently reported to the British Association his conclusions in the following terms. He says, "Great advantage to the science of terrestrial magnetism would be derived from a new magnetic survey of the southern hemisphere, extending from the parallel of 40° south as far towards the geographical pole as possible."

Intimately connected with terrestrial magnetism are the phenomena of auroras. Their nature is very obscure, but quite recently a distinct advance has been made towards discovering some of the laws which regulate them. Thanks to the labors of Dr. Sophus Tromboldt, who has spent a year within the Arctic Circle studying them, we now know that their movements are not as eccentric as they have hitherto appeared to be. He tells us that the Aurora Borealis, with its crown of many lights, encircles the pole obliquely, and

that it has its lower edge suspended above the earth at a height of from 50 to 100 miles; the mean of 18 trigonometrical measurements, taken with a base-line of 50 miles, being 75 miles. The aurora forms a ring round the pole, which changes its latitude four times a year. At the equinoxes it attains its greatest distance from its pole, and at midsummer and midwinter it approaches it most closely, and it has a zone of maximum intensity which is placed obliquely between the parallels of 60° and 70° north. The length of its meridional excursion varies from year to year, decreasing and increasing through tolerably regular periods, and reaching a maximum about every eleven years, when also its appearance simultaneously attains to its greatest brilliancy. Again, it has its regular yearly and daily movements or periods. At the winter solstice it reaches its maximum annual intensity; and it has its daily maximum at from 8 P.M. to 2 A.M., according to the latitude. Thus at Prague, in 50° north latitude, the lights appear at about 8.45 P.M.; at Upsala, 60° north latitude, at 9.30 P.M.; at Bosskop, 70° north, at 1.30 A.M. Now, while these data may be true for the northern hemisphere, it remains to be proved how far they apply to the southern. Indeed, seeing that the atmosphere of the latter region is moister and shallower than that of the former, it is probable that the phenomena would be modified. A systematic observation of the Aurora Australis at a number of stations in high latitudes is therefore desirable.

Whether or not there is any connection between auroral exhibitions and the weather is a disputed point. Tromholdt believes that such a relationship is probable (*Under the Rays*, 1,283). He says, that, "however clear the sky, it always became overcast immediately after a vivid exhibition, and it generally cleared again as quickly" (*Under the Rays*, 1,235). Payer declares that brilliant auroras were generally succeeded by bad weather (*Voyage of Tegelhoff*, 1324), but that those which had a low altitude and little mobility appeared to precede calms. Ross remarks of a particular display "that it was followed by a fall of snow, as usual" (*Ross's Voyage*, 1312). Scoresby appears to have formed the opinion that there is a relationship indicated by his experience. It is therefore allowable to regard the ultimate establishment of some connection between these two phenomena as a possible contingency. If, then, we look at the eleven-year cycle of auroral intensity from the meteorological point of view, it assumes a new interest; for these periods may coincide with the cycles of wet and dry seasons, which some meteorologists have deduced from the records of our Australian climate, and the culmination of the one might be related to some equivalent change in the other; for if a solitary auroral display be followed by a lowered sky, surely a period of continuous auroras might give rise to a period of continuous cloudy weather, with rain and snow. Fritz considers that he has established this eleven-year cycle upon the strength of auroral records extending from 1583 to 1874, and his deductions have been verified by others.

In January, 1886, we had a widespread and heavy rainfall, and also an auroral display seen only at Hobart, but which was sufficiently powerful to totally suspend communication over all the telegraph-lines situated between Tasmania and the China coast. This sensitiveness upon the part of the electric currents to auroral excitation is not novel, for long experience on the telegraph-wires of Scandinavia has shown that there is such a delicate sympathy between them that the electric wires there manifest the same daily and yearly periods of activity as those that mark the auroras. The current that reveals itself in fire in the higher regions of the atmosphere is precisely the same current that plagues the operator in his office. Therefore in the records of these troublesome earth-currents, now being accumulated at the Observatory by Mr. Ellery, we are collecting valuable data, which may possibly enable the physicist to count the unseen auroras of the Antarctic, to calculate their periods of activity and lethargy, and again to check these with our seasons. But it need hardly be said that the observations which may be made in the higher latitudes, and directly under the rays of the Aurora Australis, will have the greater value, because it is only near the zone of maximum auroral intensity that the phenomena are manifested in all their aspects. In this periodicity of the southern aurora I have named the last scientific problem to which I had to direct your attention; and I would point out, that, if its determination should give to us any clew to the changes in the Australian seasons which would enable us to forecast their mutations in any degree, it would give to us in conducting those great interests of the country which depend for their success upon the annual rainfall an advantage which would be worth, many times over, all the cost of the expeditions necessary to establish it.

Finally, there is a commercial object to be served by Antarctic exploration, and it is to be found in the establishment of a whaling trade between this region and Australia. The price of whalebone has now risen to the large sum of $10,000 a ton, which adds greatly to the possibilities of securing to the whalers a profitable return. Sir James Ross and his officers have left it on record that the whale of commerce was seen by them in these seas, beyond the possibility of a mistake. They have stated that the animals were large and very tame, and that they could have been caught in large numbers. Within the last few years whales have been getting very scarce in the Arctic; and in consequence of this two of the most successful of the whaling-masters of the present day, Capts. David and John Gray of Peterhead, Scotland, have devoted some labor to collecting all the data relating to this question, and they have consulted such survivors of Ross's expedition as are still available. They have published the results of their investigations in a pamphlet, in which they urge the establishment of the fishery strongly, and they state their conclusions in the following words: "We think it is established beyond doubt that whales of a species similar to the right or Greenland whale found in high northern latitudes exist in great numbers in the Antarctic seas, and that the establishment of a whale-fishery within that area would be attended with successful and profitable results." It is not necessary for me to add any thing to the opinion of such experts in the business. All I desire to say is, that if such a fishery were created, with its headquarters in Melbourne, it would probably be a material addition to our prosperity, and it would soon increase our population by causing the families of the hardy seamen who would man the fleet to remove from their homes in Shetland and Orkney and the Scotch coasts, and settle here.

In conclusion, I venture to submit that I have been able to point to good and substantial objects, both scientific and

commercial, to justify a renewal of Antarctic research; and I feel assured that nothing could bring to us greater distinction in the eyes of the whole civilized world than such an expedition, judiciously planned, and skilfully carried out.

THE USE OF OIL.

Masters of vessels cannot be reminded too often of the use of oil in stormy weather. Its importance is well illustrated by the fact that it is now referred to at length in standard books on seamanship; and the International Marine Conference at Washington recommended that "the several governments require all their sea-going vessels to carry a sufficient quantity of animal or vegetable oil for the purpose of calming the sea in rough weather, together with suitable means for applying it." As a good example of the directions that are now given for the best way to use oil, the remarks in a recently published book on practical seamanship, by Todd and Whall, printed on the "Atlantic Pilot Chart" for October, are of interest:—

"To cross a bar in heavy weather, after battening down all hatches, etc., take two pieces of India-rubber pipe about twenty feet long and one inch in diameter. Put these through the hawse-pipes, one on each side, and let their ends trail in the sea. On the upper end of each piece of tube lash a good-sized funnel, secure it to a stanchion in a vertical position, and station a man at each, with a three-gallon tin of colza-oil. When the vessel enters the outermost sea that breaks on the bar, let each man gently pour the oil down the pipes. This will smooth the bar immensely, and the vessel will steer much better. Almost any oil of animal or vegetable origin will do; but petroleum is not of much service, excepting to mix with and thin the other, if necessary. When lying-to in a gale, head to wind and drifting slowly, if a little oil is used, a ship ought to pull through the heaviest storm. Running in a gale, an oil-bag hung over the weather-side, or oil poured down a pipe well forward, is of great service in preventing the sea from breaking aboard; gale increasing, to round-to, prepare a sea anchor, watch for a smooth spell, and then put the helm down, heave overboard a few gallons of oil, and float the sea-anchor. Keep pouring the oil on the sea down a weather pipe or scupper while the ship is coming up to the wind. A well-equipped sailing-ship, even if deeply laden, will lie-to under a closely reefed topsail or tarpaulin in the rigging, and weather almost any gale, so long as she is not taken aback. Sailing-vessels under these circumstances nowadays often use an oil-bag paid out to windward to smooth the sea still more: this is the ideal position of a laden vessel in a dangerous storm. Whilst towing a disabled ship over a bar, or where the sea is very wicked, a couple of oil-bags over the stern will ease the sea on the tow. In a good steamer, to take a shipwrecked crew off a wreck, run to windward of the wreck, lower the lee boat, put your vessel head to sea and dead to windward, and let the boat drop down toward the wreck, veering out on the line, and constantly pouring considerable oil into the sea, which will keep the sea smooth between your ship and the wreck. In using oil-bags in heavy weather, they should be weighted, if hung over the side, in order to keep them down. When scudding, it is best to pour the oil down the closet-pipes."

NOTES AND NEWS.

We learn from *Nature* that an expedition to Greenland will start from Denmark next year, under the command of Lieut. Ryder, to investigate the east coast between latitude 66° and 73°.

—At a meeting of the Royal Geographical Society of Australasia, held at Melbourne on Aug. 22, a letter from Sir Thomas Elder was read, in which he offered to bear the entire cost of an expedition to the unexplored regions of Australia. A report on the question of antarctic exploration was also submitted to the meeting. In this report, according to *Nature* of Oct. 9, it was stated that public interest in the subject had been revived by the announcement that Baron A. E. Nordenskiöld, after a conference with his friend Baron Oscar Dickson, had consented to take the command of an expedition to the south-polar regions, on the condition that the Australian colonies contributed a sum of $25,000 towards the expenses. Baron Dickson having offered to advance the other moiety, or whatever more might be necessary. "The offers were cordially accepted, and the antarctic committee felt itself justified in making the necessary arrangements without delay for collecting the amount to be contributed by the Australasian colonies. The council of the society had passed resolutions recognizing a national duty in the exploration of the antarctic regions, especially that portion lying opposite to Australasia, pledging itself to use its influence in promoting the enterprise, and giving authority to head a subscription list in aid of the Swedish-Australian Exploration Fund with a donation of $1,000 from the society's funds. It would appear, from the hearty reception accorded to the proposals of the antarctic committee, that the latter might rely upon the energetic co-operation of all the scientific societies of Australasia, and thus be enabled to collect the amount of the contribution promised towards defraying the expenses of the combined Swedish and Australian Exploring Expedition to the South Polar Regions." The report, on being put to the meeting, was "received with acclamation."

—Mr. Robert Swordy of Dryburn Cottage, Durham, in a letter to *Nature*, the substance of which was printed in that journal for Oct. 9, gives an account of a toad (*Bufo vulgaris*) which he saw crawling out of the Pond Wood at Aykleyheads. The muscles of the toad's body were (as usual) arranged in such a fashion that the back of the toad looked like minute nodules of dark gravel embedded in a damp path below trees; but what seemed to Mr. Swordy most remarkable was, that on the top of this gravel-like arrangement of muscles there was spread a mesh or network of very fine lichen, with oval-shaped leaves of a lightish-green color, connected more or less to each other by a hair-like process of stems. This lichen spread irregularly over the toad's back, and odd sprays of it were also to be seen on the legs and upper surfaces of the feet. "Now," says the writer, "had the toad been in its regular haunts under the trees and shrubs, with this wonderful counterfeit of gravel and protective coloring, it would have been almost impossible to discriminate its form from the dark gravel, lichens, moss, wood-sorrel, and dead leaves of the place; and I doubt not that this animal's unobtrusive attire would aid it materially in capturing the insects necessary for its sustenance." Mr. Swordy enclosed photographs of the toad sitting on a section of lichen-colored gravel path, taken from near the spot where he found it.

—The following newspaper anecdote will interest those fond of animals: "A friend of the writer owns a monkey, which answers to the name of 'Jocko.' The children of the house and Jocko are boon companions, and of a summer afternoon enjoy a frolic together upon the lawn. One day some one threw a match down, and the grass ignited, making a little blaze. Jocko saw it, stopped and looked, then glanced all around, and, seeing a piece of plank not far off, ran for it, crept cautiously to the fire, all the time holding the plank as a shield between himself and the flame, then threw the plank on the fire and pressed it down and extinguished it. What child could have reasoned better and done more? Although, perhaps, no danger could have come from the fire, still, no one knows what the result might have been, and the monkey evidently believed that prudence is the better part of valor."

—The students' work in psychology at the University of Toronto, as reported by Professor J. Mark Baldwin in the last number of *The American Journal of Psychology*, has been hitherto general and theoretical. The new curriculum, however, as now ratified by the university senate, provides for more special and advanced courses, and opportunity for research. The recent fire in University College postponed the equipment of the psychological laboratory, but in the plans for the new buildings more ample accommodations are secured. The new laboratory is to be in the restored building in a retired portion of the first floor immediately over the rooms of the physical department. It will comprise two communicating working rooms, each 16 by 21 feet; a professor's private room, to be used also as a special psychological library under charge of a fellow or instructor; and a dark room available

from the resources of the physical laboratory. The first two rooms will be separated by a hall from the latter two. The equipment, apparatus, etc., may be delayed in consequence of the present severe tax upon the resources of the university, but special researches will be prosecuted with the aid of adapted apparatus kindly loaned from the very complete collections of the departments of physics and biology. The design is to encourage serious endeavor and stimulate interest in the outlying questions of the sciences, principally among post-graduates. Private facilities will be given whenever possible for experiments in psychometry and psychophysics. It is hoped that the work may be expanded to include problems in medical and abnormal psychology, since the city and provincial institutions present abundant facilities; but nothing in this line has been projected as yet. During the past year the students of the department have formed a psychological society for discussion and presentation of papers, conducted entirely by themselves. The object of the society is breadth of information rather than new work. They treat psychological questions, however, quite apart from speculative philosophy. The library was totally destroyed by the fire; but the new collection is growing rapidly, especially in this department, owing to the notable generosity of friends at home and abroad. In another year it will probably be more complete in psychological publications than before. The teaching force is at present Professor J. Mark Baldwin and a fellow. After next year Professor J. G. Hume is to assume his duties, and a post-graduate scholarship in philosophy is to be established in memory of the late Professor Young. Thus four, at least, will be the official in charge. The following are the subjects of researches now in progress: "Beginnings of Voluntary Movement in Childhood," "Sense of Effort," "Recognition," together with special topics for Professor Baldwin's proposed volume on "Feeling and Will."

—Following the appropriation and authority of Congress for its action, the Mississippi River Commission, after about a year of suspended business, held its first meeting of the present fiscal year at the Army Building in New York City, at which all the members of the board were present, beginning on the morning of Oct. 1, and continuing until the afternoon of the 4th. The first days of the session were given to the public hearing of parties interested in the protection and improvement of the Mississippi River, represented by the State engineers, and organized bodies of citizens, mainly from the lower sections of the river, together with a more general discussion by other parties of the commercial and economic questions relating to the entire valley. The latter part of the time was given, in private session, to the direct business of the commission, in allotting the appropriation made by Congress —three million two hundred thousand dollars—to the various works of protection and improvement on the river. Since the first organization of the commission, some changes have taken place in its *personnel*, and it now consists of the following members: Col. Cyrus B. Comstock, Corps of Engineers, president (Army Building, New York City); Lieut. Col. Charles R. Suter, Corps of Engineers, U.S.A. (St. Louis, Mo.); B. M. Harrod, civil engineer (New Orleans, La.); Hon. Robert S. Taylor (Fort Wayne, Ind.); Major Oswald H. Ernst, Corps of Engineers, U.S.A. (War Department, Washington, D.C.); Henry Flad, civil engineer (St. Louis, Mo.); Professor Henry L. Whiting (U. S. Coast and Geodetic Survey, Washington, D.C.); Capt. Carl F. Palfrey, Corps of Engineers, U.S.A., secretary of the commission (with main office at St. Louis, Mo.). The next meeting is to be held on board the government steamer "Mississippi" at St. Louis, whence the commissioners will proceed on an inspection of the river, and the parties carrying on the various works along its course between Cairo and the Head of the Passes.

—A valuable contribution to the subject of atmospheric electricity has been lately made by Professor L. Weber, who, in experiments at Breslau, used a sensitive, earth-connected galvanometer, instead of the electroscope in Exner's method, as we learn from *Nature* of Oct. 9. Using Exner's metallic rod and flame, he found that the currents were extremely small, about a micro-milliampère (or the thousand-millionth part of an ampère). They were increased with a longer rod and bigger flame; but much better results were got with a kite or captive balloon. The edge of the kite was coated with silver paper, and the tail was formed with tassels of the paper. A line of fine steel wire was used, and about twelve feet at the upper end were of non-conducting string. Experiments were made on twelve cloudless days. Taking the intensities of current as ordinates, and the heights to which the kite (or balloon) rose as abscissæ, the curve of intensity had its convex side to the axis of abscissæ. On but few days was the current negative, this effect being probably due, the author thinks, to dust charged with negative electricity which it gave to the line. This might neutralize some of the positive electricity set flowing in the wire by the earth's induction. Professor Weber considers that any experiments on the earth's surface with short conductors can at best give relative values, and determine periodical changes. His values differ not inconsiderably from Exner's. At a height of 350 metres (1,166 feet) the potential was found to be 96,400 volts; and, assuming a regular increase of potential with height, the fall of potential would here be 275 volts. The potential of the earth is estimated at the enormous value of $1,720 \cdot 10^6$ volts. Supposing the volt to be about the electro-motive force of a Daniell element, a huge battery of this number of elements would be needed to produce the earth's potential; the zinc pole being connected with earth, and the copper led into space. Professor Weber considers the question of possible electric repulsion from the earth, and is led to some instructive remarks on rain-particles, clouds, etc. Some very interesting effects were obtained from thunder-clouds; but for these and other matters we would refer the reader to the original (an account of these researches appears in *Humboldt* for September).

—Naturalists will read with interest a paper in *Humboldt* for September, in which Professor Forel of Zürich gives the results of a visit he paid to Tunis and eastern Algeria, chiefly to observe the ants there. Looking from a ship at the dreary gray wastes, and the large date-palm oasis of Gabes, according to *Nature*, one fancies all animal life must be concentrated under the palms. But really there is very little of it there, and hardly any thing singular; while the sand of the desert contains, round each of the poor, small, sparse plants, a host of beetles and other insects, many of them with striking adaptations and peculiarities. Some live on excrement of camels, asses, etc.; some on the plants; and some prey on other animals, big and small. In one ant-hill he found that several ants had a small brown object clinging to the lower part of an antenna; in some cases, one on either antenna. On examination, this fell off, and was found to be a small beetle, which evidently clings there as guest. It has tufts of hair, which are probably licked by the ant. The host did not seem to trouble itself about this little creature, which, by its odd post, is enabled to accompany the ant in its wanderings and changes of abode. Professor Forel remarks on the peaceful character of the ants in that region. With few exceptions they avoid fighting, and only one ant was found capable of piercing the human skin.

—The phenomenon of globular lightning was imitated by M. Planté, it will be remembered, with his secondary batteries. It has been shown by Herr von Lepel, as we learn from *Nature* of Oct. 16, that this can also be done with so-called statical electricity, obtained from an influence machine. Two thin brass-wire points from the poles of a powerful machine being held at a certain distance from the opposite sides of an insulated plate of mica, ebonite, glass, or the like, there appear small red luminous balls, which move about, now quickly, now slowly, and are sometimes still. Even better effects were had with a glass or paper disk which had been sprayed with paraffine. Small particles of liquid or dust seem to be the carriers of the light. A slight air-current makes the spherules disappear with hissing noise. These spherules, the author remarks, are phenomena of weak tension: an increase of the tension gives a rose spark-discharge. Various interesting analogies with globular lightning are traced.

—In *Science* of last week, p. 248, first column, 20th line, "efferent sensations" should read "afferent sensations;" 21st line, "Memories of movements" should read "Memories of movement;" 22d line, "afferent feeling" should read "efferent feeling."

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

THE CULMINATING POINT OF THE NORTH AMERICAN CONTINENT.[1]

AMONG the objects for which the expedition recently organized under the auspices of the Academy of Natural Sciences of Philadelphia was despatched to Mexico was the determination of the physical features of the giant volcanoes of the South, with special reference to a study of the vertical distribution of animal and vegetable forms. While prosecuting our observations in this direction, I took the opportunity, in company with one or more of my associates, of scaling the four loftiest summits of the land; namely, the peak of Orizaba, Popocatepetl, Ixtaccihuatl, and the Nevado de Toluca. This gave me the advantage of making personal comparisons between the life that existed in different regions of "cloud-land," at the same time that it offered me the opportunity of more closely investigating the geological features of some of the most gigantic volcanic mountains known to us. Numerous measurements of altitude were made during the ascents, and, in the higher regions, always with the same instrument. This was a registered aneroid, tested and corrected at Philadelphia (immediately before the starting, and shortly after the return of the expedition) at the sea-level of Vera Cruz, and in the Central Meteorological Observatory of the City of Mexico, at an elevation of 7,403 feet. To the officers of the latter institution I am indebted for the privilege of making comparisons with the standard mercurial column.

[1] From the Proceedings of the Academy of Natural Sciences of Philadelphia.

The results of our measurements show a striking accord in some instances with those obtained from earlier measurements, while in other cases they exhibit marked divergence. The fact that all the summits were ascended within a period of three weeks, were measured with the same instrument, and during a period of atmospheric equability and stability which is offered to an unusual degree by a tropical dry season, renders the possibility of errors of any magnitude almost *nil*. At any rate, such errors as may have crept in will probably not affect a general comparative result. The points of important difference are: (1) the highest summit of Mexico is not, as is commonly supposed, Popocatepetl, but the peak of Orizaba (Citlaltepetl, the "Star Mountain"), which rises 700 feet higher (18,200 feet); (2) Ixtaccihuatl, the familiar "White Woman" of the plain of Anahuac, is but a few hundred feet (about 550) lower than Popocatepetl.

The peak of Orizaba was ascended on the 6th and 7th of April, Popocatepetl on the 16th and 17th of the same month, the Nevado de Toluca on the 21st, and Ixtaccihuatl on the 26th and 27th.

The restoration of the peak of Orizaba to the first place among Mexican mountains, and its increased altitude, open up the interesting question as to what constitutes the culminating point of the North American continent. The only other mountain that need be considered in this connection is St. Elias, situated approximately on the 141st meridian of west longitude, and whose summit is claimed for both the possessions of Great Britain and the United States (Alaska). The measurements of this mountain depart so widely from one another, however, that we are not yet in a position to affirm, even within limits of a thousand feet or considerably more, how nearly it approaches in height the Mexican volcanoes. We are probably justified in dismissing without further examination the measurement made by La Pérouse in 1786, which gave for the peak less than 13,000 feet; and seemingly not much more reliable is the datum (14,970 feet) which appears in Capt. Denham's chart from 1853 to 1856, and is copied into the British Admiralty chart of 1872 (Humboldt's *Cosmos*, v. p. 419, Otté's edition; Dall, *Report of the United States Coast and Geodetic Survey for* 1875, p. 159). This latter figure (4,562 metres) is adopted by Petermann in his general map of North America prepared for Stieler's "Hand-Atlas" (1878–81). Malespina in 1791 determined the height, by means of angles taken from near the position of Port Mulgrave, to be 5,441 metres, or 17,851 feet; and the equivalent of this figure has been copied into the Russian hydrographic charts (1847). Tebenkoff reduces this amount by somewhat over 900 feet.

No carefully conducted measurements of the mountain appear to have been made between the date of the publication of Tebenkoff's chart (1849) and 1874, when Mr. Dall, under the direction of the United States Coast Survey, surveyed a considerable portion of the Alaskan region.[1] This investigator found four different values for the height of the mountain as measured from four points respectively 69, 127, 132, and 167 miles distant: these are 19,464, 18,350, 19,956, and 18,033 feet. Mr. Dall dismisses all of these as having little value, except the measurement of 19,464 feet, made from Port Mulgrave. It is difficult to reconcile the

[1] Mr. Dall, in his report above referred to (p. 159), quotes from Leopold von Buch an additional measurement of the mountain, namely, 16,758 feet. Grewingk (Verhandl Russ.-Kaiser. Mineralog. Gesellsch., 1848–49 [1850], p. 99) gives the same figure, referring likewise to Buch (Canar. Inseln, p. 390); and a further reference appears in Davidson's Coast Pilot of Alaska, 1869, p. 142, note (16,754 feet, according to Grewingk). But this figure is manifestly Malespina's measurement given in French feet, which resolved is equal to 17,860 feet; and Grewingk himself quotes Malespina's measurement (5,441 metres) on p. 404 of his report. Humboldt (*op. cit.* v. p. 252) credits the measurement of 17,835 feet to Quadra and Galeano; but, as these observers were associated with Malespina, it is more than probable that the data here given are those which have been generally attributed to Malespina. Humboldt intimates that the measurement is perhaps one-fifteenth too great; but whether this assertion rests on certain facts contained in Malespina's manuscripts, which the great German traveller found among the Archives of Mexico (p. 419), or not, is not stated.

vast range of these measurements, whose extremes vary to an extent of upwards of 1,900 feet, or to one-tenth of the height of the entire mountain, except on the assumption that the angles of measurement were too small to permit of exactitude in the result. And, indeed, Mr. Dall himself rejects all his measurements except those made from Port Mulgrave, giving them "no weight in the result, as they were all taken at great distances from the peak, and subject to various disturbing influences and uncertainty in most of the positions" (p. 164). And yet it is upon the accurate determination of the position "At Sea," 127 miles distant, that "the position of Mount St. Elias depends" (p. 165); and necessarily upon the determination of this position must also depend the accuracy of the measurement of height. Malespina's measurement was made from a point apparently very close to that occupied by the Coast Survey officers, and his results, as has already been seen, vary negatively by 1,600 feet; but he estimated the distance separating him from the mountain at 55.1 nautical miles. Mr. Dall remarks, in relation to the discrepancy existing between the two measurements, that the doubt lies wholly with the distance. But this does not explain the great range in Mr. Dall's own results. And we are perhaps led to be the more suspicious regarding the value of these when we take into account the discrepancies which appear in the determination of the altitude of Mount Fairweather. Three series of sextant observations were made of this mountain from the region about Lituya Bay and Cape Spencer, with the result of obtaining an average value of 15,447 feet. Vertical circle measurements of the same mountain made from Port Mulgrave indicate 15,270 feet, while the average of all measurements is 15,423 feet. Mr. Dall calls attention to the close correspondence of these results, and comments more particularly upon the "unanimity in the Lituya Bay observations."[1] A reference to the exact results obtained, without recourse to the delusive system of extracting averages, shows, however, that in place of unanimity we have the reverse. Thus, the sextant observations taken from "Off Cape Spencer" indicate 16,009 feet; those from "Off Lituya Bay," 15,247 feet; and those from "Off Lituya," 15,085 feet (*op cit.* p. 174),—a difference in extremes of upward of 900 feet. This divergence in the measurement of a mountain three miles ($\pm$) in height from positions twenty to fifty miles distant makes very doubtful the results obtained in the case of St. Elias, where the distances were still very much greater, and the angles of observation correspondingly smaller.

In view of the broad divergence existing in these later measurements, and the fact that all earlier determinations give less than 18,000 feet for the height of Mount St. Elias, geographers will probably consider the question of absolute height as still an open one. That the mountain closely approximates the giants of the Mexican plateau is almost certain; but it seems equally probable that its true position is after, and not before, the peak of Orizaba.

ANGELO HEILPRIN.

[1] Including here the measurements made off Cape Spencer.

THINNESS VERSUS STOUTNESS.

THE following facts on the value of emaciation, from the *Lancet* of Sept. 27, are of interest. Emaciation is a prominent feature in many diseases. Many of the phenomena of disease are, in reality, efforts at repair. It will therefore be advantageous to inquire if some good purpose is not served by emaciation. To begin with diseases which affect the circulation, in many such we may note that the patient will rapidly lose flesh, and that when the loss has proceeded to a certain degree it is arrested. The patient becomes and continues thin. Not only is it difficult to fatten him, but he is not much benefited by the attempt. Should his disease be arrested, but leave some injury behind, the patient will probably continue thin. Instinctively, in consequence, we look for the presence of disease, active or quiescent, in sparely developed persons; and practically we look for it in the territory of the circulation, either pulmonary or systemic, and generally find something. Such emaciation, ceasing at a certain point, does not much exceed what is seen in athletic training, and may be defined as an involuntary training, forced upon the patient by his ailment. What, briefly, is the benefit of training? Unusual effort in untrained men or animals is checked, not by muscular exhaustion, but by congestion of the pulmonary circulation, and paralysis of the right ventricle of the heart. The effect of training is to enable the pulmonary circulation to keep pace with the increased activity of the systemic. Several changes concur to this end,—dilatation of the lung and of its blood-vessels, hypertrophy of the right side of the heart, and most especially absorption of every tissue which is found to be superfluous for the effort in view. This absorption reduces the area of the systemic circulation; and it is followed by a reduction in the quantity of blood, because a smaller quantity will suffice for active circulation through the lesser area. The individual so trained is in the condition of having a pulmonary territory larger than is necessary for his state of rest, and consequently with a greater margin for relief upon exertion. Conversely, the contrary condition of obesity develops the systemic circulation to the full capacity of the lungs, so that the least exertion will produce dyspnœa. Acute disease being like exertion, we can see the advantage of entering upon it in a state of training. The exhaustion to be feared is that of the heart's right ventricle; and the inconvenience of existing stimulants is, that they do not stimulate the right ventricle by itself.

To return to emaciation as produced by disease. Let us first take the case of diseases of the lung. Should the territory of the pulmonary circulation be diminished by such a disease as phthisis, it would be impossible for the patient, without emaciation, to have an active circulation in the systemic area without danger of congestion of the lung. The feeble attempts that are made at hypertrophy of the lung in this disease are thus met half way. The same thing is true of all emphysema of the lungs, whether senile or morbid. Then we may consider the disorders of the greater circulation. In disease of the valves, when the muscle has to do the work of the valves, and in decay of the aorta, when the ventricle has to combine the aorta's duty with its own, the smaller the volume of blood to be dealt with, the better. Without reduction of the area through which it flows, a reduced amount of blood would only result in a sluggish circulation. Emaciation in such cases is therefore salutary. Moreover, the capillaries are the seat of greatest friction: they are therefore the part to be reduced. This is the reason why all animals, in a state of nature, grow thin as they grow old. Man, and the creatures under his control, may violate this law, but not with impunity. Acute disease, when the arteries are decayed, is doubly dangerous. The right ventricle of the heart may be exhausted, as before, but now the left ventricle may also prove unequal. Stimulants here can have but little drawback; but in surplus lung, and an amount of blood that is well within the powers of propulsion, lies a greater safety. Obesity is dangerous to the aged.

It would be well to consider the phenomena of waste in fever by the light of an assumption that they are salutary. The brute creation, when suffering from fever, eat nothing; yet they do not die, but recover. The body seems destined to feed upon itself, and to delay all repair until convalescence. Great responsibility rests upon those who supersede this instinct by an artificial method. Graves, who fed fevers, at the same time bled his patients. Venesection has this drawback, that to relieve the right heart we are obliged to stint the left, and to reduce the systemic circulation to a sluggish flow. The speedy repair of such loss of blood shows that its benefit must be only temporary. Such a remedy is an imperfect substitute for a capacious lung. The perception of this inconvenience has led to the disuse of bleeding. The concomitant pressing of food in fevers should probably follow it. The most evident of natural remedies for any kind of fever are starvation and emaciation. However indulgent appetite may be in health, it returns in disease to the strictest authority. Obedience to its dictates may shatter superstitions, but will not jeopardize the cure. In chronic diseases, the physician who thinks of the future of his patient will look grudgingly on fat. It provides for warmth and irregularity of nutrition. If these be provided for in other ways, much relief can be given to the circulation; and if in acute disease the presence of a tissue should prove an embarrassment, the physician will not interfere with its removal.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Structure of the Plesiosaurian Skull.

It is somewhat remarkable, that, in a group of fossil reptiles like the plesiosaurs, the nature and structure of the skull should have remained for so long a time practically unknown. Fragmentary remains of this very important part of the skeleton are not rare in collections, but none sufficiently complete to make out any thing at all satisfactory of its anatomy have hitherto been described. Very fortunately the museum of the Kansas University has recently been enriched by the skull and a large part of the neck of one of these animals, in most remarkably perfect preservation, collected from the Kansas Niobrara cretaceous by Judge E. P. West, assistant in paleontology at the State University. Recognizing the value and rarity of the specimen, Mr. West used the most scrupulous care in removing and shipping the specimen, and, as now cleaned from its matrix in the museum, it permits most of its structure to be made out with certainty and ease. I have in preparation a full description of the specimen, with illustrations, which will shortly be published in the "Transactions of the Kansas Academy of Sciences." Meanwhile, however, the very great importance of the find renders a brief description of its chief characters at the present time very desirable.

The species I refer provisionally to the genus *Cimoliosaurus*, though certain characters, as will be seen, do not accord with those given by Lydekker in his recent "Catalogue of Fossil Reptilia." The specimen lies upon its side, with twenty-six vertebræ in position; and all, save some of the posterior vertebræ, which were exposed, are in perfect preservation. The cervical vertebræ have the arches and riblets fully co-ossified with no or but very slight traces of their sutural attachments. There is but a single rib attachment, and the zygosphene is rudimentary. The spines are short; the anterior centra, gently cupped; the posterior ones, which increase gradually in slenderness, more deeply so. The parietal bone forms a roof-shaped covering, ascending into a high, thin sagittal crest two or three inches above the brain-case: there is no parietal foramen. There is but one temporal arcade, a broad bar passing directly backward, on a line with the maxilla, to unite with the lower part of the quadrate. The limits of the quadrato-jugal have not yet been satisfactorily made out. The post-orbital is a slender bone uniting broadly with the jugal below, and has no connection with the slender squamosal. There is apparently no post-frontal. Lying within the comparatively small orbit are eleven or twelve sclerotic plates, touching each other at their edges, and forming the larger part of a ring, a few having been misplaced. The mandibular symphysis is short, and the two sides are so firmly co-ossified that I have found no trace of the suture. There are about twenty teeth in each jaw, extending far back, the anterior ones very much larger than the posterior ones; in the locked jaws the upper ones reaching nearly to the lower margin of the stout mandible. A part of a single bone was found between the jaws, which I believe to pertain to a hyoid.

I need not point out the importance of the foregoing characters. Others scarcely less interesting will be given later. The ones here given, however, are nearly all in conflict with generic, family, ordinal, or even super-ordinal characters hitherto accepted. The sclerotic plates are the first ones described for any of the *Synaptosauria*, a branch comprising the *Chelonia* and *Sauropterygia*.

The species can be located with neither *Polycotylus* or *Elasmosaurus*, the two genera of the American cretaceous hitherto described as having co-ossified neural arches. I place it, however, under *Cimoliosaurus*, in Lydekker's acceptation, and shall describe and figure it under the name *C. Snowii*, in honor of Chancellor F. H. Snow, who has done so much for the development of the natural-history department of our university. I append a few measurements: length of skull from occipital condyle to top of premaxilla, 18 inches; greatest height of skull to top of parietal crest, 9 inches; length of centrum of second cervical vertebra, $1\frac{5}{8}$ inches; height of centrum of second cervical vertebra, $1\frac{5}{8}$ inches; height of spine above centrum, same vertebra, $2\frac{1}{2}$ inches; length of centrum of eighteenth cervical vertebra, $2\frac{3}{4}$ inches; height of centrum, same vertebra, 2 inches; length of centrum of twenty-fifth cervical vertebra, $3\frac{5}{8}$ inches.

S. W. Williston.

University of Kansas, Oct. 25.

On the Characters and Systematic Position of the Large Sea-Lizards, Mosasauridæ.

A nearly complete skeleton of one of the mosasauroid reptiles, collected during the summer in the cretaceous of Kansas, enables me to give full characters of this family, and to determine absolutely its relations.

The skull is nearly, in every respect, of the pattern of the *Varanidæ;* the premaxillaries co-ossified with nasals, forming a single bone; frontals single, but indications of former division in front; parietals single; post-orbital arch complete,—a bony postorbito-quadrate arch. This arch is formed by the postfronto-orbitals, which are free from each other in young specimens, and by the quadratojugal (squamosal); pterygoids and palatines separated, pterygoids with teeth; vomers separated behind, connected in front; a small ecto-pterygoid (transverse bone); infra-orbital fossa as in *Varanidæ;* nasal opening formed by naso premaxillary, frontal, prefrontal, maxillary; orbits formed by prefrontal, jugal, postfronto-orbital, and a very small portion of the frontal; epipterygoid as in *Varanidæ;* no ossified alisphenoid; par-occipital (opisthotic) co-ossified with ex-occipital; petrosal (pro-otic) suturally united or co-ossified with ex-occipital and par-occipital; quadratojugal, squamosal, par-occipital, and quadrate, exactly in the same relations as in *Varanidæ;* lower jaw as in *Varanidæ*.

I have to mention here the important fact that the *Varanidæ* and *Helodermatidæ* have, like the *Mosasauridæ*, the peculiar articulation in the middle of each ramus, which enables these animals to extend the lower jaws considerably. The shoulder-girdle is between that of *Varanidæ* and *Helodermatidæ*. There is a very well developed interclavicle, a little divided at the proximal end. The clavicles are small and slender.

From all this it is evident that the *Mosasauridæ* are very closely related to the *Varanidæ*. They simply represent highly specialized aquatic forms. The enormous size of some of the *Mosasauridæ* has to be explained by that fact. I may remark here, however, that some fossil *Varanidæ* (*Varanus*) [*Megalonia*] *priscus*, Owen, for instance) from the pleistocene of Queensland reached a length of thirty feet. The *Helodermatidæ* belong to the same group, but the *Mosasauridæ* are very much nearer to the *Varanidæ*. For this group I retain the old name *Platynota*, and divide it into two superfamilies, — (*a*) *Varanoidea*, 1. *Varanidæ*, 2. *Mosasauridæ;* (*b*) *Helodermatoidea*, 1. *Helodermatidæ*.

A full account of the *Mosasauridæ*, with figures, will soon be published.

G. Baur.

Clark University, Worcester, Mass., Oct. 29.

Two New Species of Tortoises from the South.

Through the kindness of Mr. Gustave Kohn of New Orleans, La., I have received for examination a splendid collection of *Testudinata* from the Southern States: Louisiana, Florida, Alabama. This collection contains two new species of *Malacoclemmys*.

1. *Malacoclemmys oculifera* (*sp. nov.*).—This is one of the most beautiful of the American tortoises, and it is certainly very remarkable that it has not been described before. It was labelled *M. Lesueuri*, but it is totally different from that. The shell is broader and higher. The bony tubercles on the vertebral plates are more developed. Each of the dermal scutes of the carapace contains a yellow ring, bordered on the inside and outside with dark olive-brown. These rings are especially well developed on the costal scutes. This condition induced me to propose the name *oculifera*. The plastron is yellow, but with markings very much like *Chrysemys bellii*, Gray. The color of these markings is like the carapace, olive-brown. The head is entirely different from that of any of the described forms of *Malaco-*

clemmys. There is a large yellow spot behind the eyes, two yellow stripes from the orbit backwards, and a very characteristic yellow stripe covering the whole lower jaw. The upper and lower jaws are rounded in front. There are males and females in the collection. The localities where these tortoises were found are Mandeville, La., and Pensacola, Fla. Specimens from Mandeville, La., I consider as the types. Such specimens are also in the collection of the Smithsonian Institution, Washington, D.C., sent by Mr. G. Kohn, No. 15,511, etc.

2. *Malacoclemmys Kohnii* (*sp. nov.*).—Three specimens labelled *M. geographica* are in Mr. Kohn's collection. They represent another interesting new species. The form of the shell is much like that of *M. oculifera*. The coloration is totally different, and resembles very much that of *M. Lesueuri*. The skull is quite different from that of *M. geographica*. The alveolar surfaces of the upper jaw do not meet in the middle line as in *M. geographica*: they are not so broad, therefore. They resemble more *M. Lesueuri* in that respect, but are broader. The symphysis of the lower jaw is longer than in that species. The coloration of the head is also quite different from *M. Lesueuri*: there is no big yellow spot behind the eye, but a thin yellow line, which is connected with another one running behind from the upper part of the orbit. The localities where found are Bayou Lafourche, La.; Bayou Teche, St. Martinsville, La.; Pensacola, Fla. I take the Louisiana forms as types. I have named this species in honor of Mr. G. Kohn, who collected the specimens.

From this it is seen that we have now five species of *Malacoclemmys* in the United States,—*M. terrapin*, Schoepff; *M. geographica*, Les.; *M. Lesueuri*, Gray; *M. oculifera*, *sp. nov.*; *M. Kohnii*, *sp. nov.*

It is probable that *M. terrapin*, the common diamond-back, shows variations according to different localities, and I should be very glad to get specimens from different points on the coast. The new species will be fully described and figured soon.

G. BAUR.

Clark University, Worcester, Mass., Oct. 27.

Remains of the Primitive Elephant found in Grinnell, Io.

HOWEVER common the remains of the mammoth may have become, there is always more or less interest attached to the discovery of each new individual, however fragmentary, or wherever found. According to vague rumors, the first evidence of the mammoth's remains in Grinnell came to light so early in the history of the town, that it has passed into obscurity; and the bones, treasured for a time as private relics, have simply disappeared, no one knows just when or how. It is not certain whether this doubtful specimen was a distinct individual, or part of the one subsequently found near the same place. The last one alluded to was found in 1884, while breaking ground for the Eagle Block, on the north-east corner of Main Street and Fourth Avenue. This animal, a large adult male, is represented by a tusk (eight feet long and nine inches in diameter), several grinders, lower jaw, and part of zygomatic arch, preserved in the museum of Iowa College. These bones occurred about five feet below the surface, and were in an exceedingly soft and perishable condition, as similarly situated remains usually are; but, owing to the skill of Professor H. W. Parker, the tusk and teeth especially were so well fixed with hardening-mixtures, that they were removed in an exceptionally fine condition. The other bones were naturally more fragmentary. The mandible is represented by a large fragment, including the entire symphysial region, the left ramus being complete as far as the angle. No limb bones in whole or part were taken out with these fragments, although many bones were seen in the clay passing under the walls of an adjoining block, endangering its foundations if dug out, and consequently left there. Doubtless when other excavations are made on the lots immediately adjoining, other bones will be found. Judging by the condition of the parts now at hand, it is not unreasonable to hope that a skeleton nearly complete may yet be unearthed.

Remains of another *Elephas primigenius* have just come to light, found Oct. 6, 1890, within half a mile of the site of the one of 1884. There is additional interest attached to this one, because of the depth at which it occurred. Workmen, while engaged in excavating an enormous well to supply the water-tanks of the Iowa Central Railroad, came upon certain badly broken mammoth bones, in the drift clay and pebbles, at a depth of twenty feet. All the bones, save a well-worn molar, were badly comminuted, and all the surroundings lead inevitably to the conclusion that they were transported with the drift in which they occurred. In addition to the small though complete molar, there were limb bones, a scapula, ribs, and a small tusk some five or six inches in diameter. The tusk, however, extended into the sides of the well in such a way that it could not be taken out without danger of a cave-in, and was left. The scapula, when found, was fairly complete, but was almost destroyed in the taking-out, little beside the thickened parts in the region of the glenoid fossa remaining. The few limb bones, owing to their fragmentary condition, coupled with the inexperience of the workmen in digging out such remains, were almost totally destroyed; the proximal end of a tibia, a fragment of the shaft of a femur, and the casts in clay of the medullary cavities of the same, being about all that remains to show for them at all. Although it is by no means uncommon to find skeletons of mammoths close to one another, yet it is less so to find them so far below the surface. ERWIN H. BARBOUR.

Iowa College, Grinnell, Io., Oct. 15.

Photo-Mechanical Work.

I WISH to remove, as far as may be, a wrong impression which your readers get from a short news item in your issue of Oct. 24, p. 231. Speaking of the coming exhibition by the Camera Club, of work by the several photo-mechanical processes, you say that "it is a remarkable fact that in no exhibition have they [photo-mechanical results] been brought together for comparison and study."

This statement is very misleading. In the United States National Museum in Washington, in the Section of Graphic Arts, under Mr. S. R. Koehler's management as curator, a large space (I think about nine hundred square feet of wall and cases) is devoted solely to photo-mechanical work and processes. This collection is both historical and technical; and I am perfectly safe in saying that there is no exhibition or collection of the kind anywhere that comes near it in instructiveness, general excellence, and beauty. In completeness the specimens here brought together form a remarkable whole, extending from the earliest times without a break to the present day.

The Camera Club will, I do not doubt, make a beautiful exhibition of recent photo-mechanical work; but the older necessary steps in the evolution of these arts, most difficult to get and most difficult to present effectively for educational and comparative purposes, are not likely to be represented in New York as they are in the National Museum here. J. W. OSBORNE.

Washington, D.C., Oct. 30.

MY attention has been called to a note in your issue of Oct. 24, announcing an exhibition of photo-mechanical process-work to be held by the New York Camera Club. In this note it is stated to be "a remarkable fact that in no exhibition have they [i.e., the photo-mechanical processes] been brought together for comparison and study." By referring to the "Classification of Exhibits in the Section of Graphic Arts," of the Smithsonian Institution, United States National Museum, you will see that considerable space is devoted to the illustration of the processes in question at the institution named. We endeavor not only to illustrate the various processes in their technical aspects and in their results as they are seen to-day, but it is our aim also to bring together an historical series; and I am happy to say that our efforts in this direction have not been quite unsuccessful. Among the specimens illustrating the development of the photo-mechanical processes historically is one by Nicephore Niepce (1824), while Fox, Talbot, Poitevin, Paul Pretsch, Tessié du Motay, Asser, Toovey, Osborne, Sir Henry James, Davanne, Lemercier, Pouncy, Bradford (of Boston), and others, are represented by several specimens each. That the workers of to-day, especially those of America, are well represented, goes without saying.

For these results the United States National Museum is largely

indebted to Mr. J. W. Osborne of Washington, Professor Chandler of Columbia College, New York, Mr. Ives of Philadelphia, and to nearly all the leading houses engaged in photo-mechanical work in New York, Philadelphia, and Boston. Permit me to add that further assistance, from whatever quarter it may come, will be gladly accepted and duly acknowledged.

The "Catalogue of the Contributions of the Section of Graphic Arts to the Ohio Valley Centennial Exposition, Cincinnati. 1888," shows that the modern photo-mechanical processes were very fully illustrated in the exhibition. S. R. KOEHLER.

Washington, D.C., Oct, 31.

BOOK-REVIEWS.

An Easy Method for Beginners in Latin. By ALBERT HARKNESS. New York, American Book Company. 12°.

THIS new volume by Professor Harkness approaches the Latin language on what may be called its practical side, being intended, not as a mere companion to the grammar, but as a useful guide in the work of reading, writing, and speaking the language. It is at once a book of exercises and a reader, containing enough grammar to suffice for the beginner. From the outset practical use is made of the language as such, the complete sentence—verb, subject, and object—being introduced in the very first chapter.

The exercises throughout the book are mainly conversational; and great care has evidently been taken to select interesting and instructive subjects, to present them attractively, and to enliven them by the frequent introduction of anecdotes, stories, dialogues, etc. Questions in Latin on the subjects treated are introduced regularly, not to be translated, but to be answered in Latin, treating the language to some extent as a living instead of a dead one. This must greatly lighten the task of the learner, though it need not necessarily endanger the thoroughness of his work.

The method of treatment adopted by Professor Harkness in this work is largely inductive. Grammatical principles are presented to the learner embodied and illustrated in the language itself, before he is called upon to use them in constructive work. It must not be understood from this that the grammar has been neglected. It is simply approached from a different point, introduced as needed in the exercises, and applied in a way that lightens the task of learning it, and fastens it in the memory by immediate and constant use. The book is illustrated by four full-page colored plates and a number of engravings of classical subjects treated of in the text and reproduced from authentic sources. On the whole, the new volume is a valuable addition to the series of Latin text-books by the same author, so well-known to our educators.

AMONG THE PUBLISHERS.

IN the November *Magazine of American History*, Rev. Charles H. Parkhurst contributes the opening chapter, "Divine Drift in Human History." The second article, "American Outgrowths of Continental Europe," by the editor, is based upon the "Narrative and Critical History of America." It is followed by Gen. Winfield Scott's "Remedy for Intemperance," from Hon. Charles Aldrich; "The Puritan Birthright," by Nathan M. Hawkes; and "The Action at Tarrytown, 1781," by Dr. R B. Coutant. One of the longest papers in the number is that of Dr. Prosper Bender, the third in his series of "The French-Canadian Peasantry." The "Library of a Philadelphia Antiquarian," by E. Powell Buckley, will be perused with interest by all scholars. "Revolutionary Newburgh" is an historic poem by Rev. Edward J. Runk. A glimpse of the "Literature of California" is from the writings of Hubert Howe Bancroft.

—*The Illustrated American* gives a new point to a well-worn problem. It says, "When a wheel is in motion, does the top move faster than the bottom? Nine people out of ten would cry

'Nonsense!' at the mere question. Both the top and bottom of the wheel must of necessity, it would seem, be moving forward at one and the same rate; i.e., the speed at which the carriage is travelling. Not so, however, as a little reflection would convince you. The top is moving in the direction of the wheel's motion of translation, while the bottom is moving in opposition to this motion: in other words, the top is moving forward in the same direction in which the carriage is progressing, while the bottom is moving backward or in an opposite direction. That is why an instantaneous photograph of a carriage in motion shows the upper part of the wheel a confused blur, while the spokes in the lower part are distinctly visible."

—Messrs. Houghton, Mifflin, & Co. have just published as a second reader, "Fables and Folk Stories," phrased by Horace E. Scudder. This book contains literature which the world has chosen to remember. Mr. Scudder's literary taste, clearness of style, and hearty sympathy with children, have enabled him to clothe these classic stories in classic language suitable for children who are prepared for a second reader. The first half of the "Fables and Folk Stories" has also been published as No. 47 of the Riverside Literature Series The second half will be published on Dec. 3 as No. 48 of the same series.

—Messrs. Kegan Paul, Trench, Trübner, & Co.'s October announcements include among many others the following of special interest to our readers: "Essays, Scientific and Philosophical," by the late Rev. Aubrey Lackington Moore; "The Philosophy of Right," by Professor Diodato Lioy, translated from the Italian by W. Hastie, B.D.; "Confucius, the Great Teacher: a Study," by Major-Gen. G. G. Alexander, C.B.; "The Life of Philip Henry Gosse, F.R.S.," by his son, Edmund Gosse; "Disraeli and his Day," by Sir William Fraser; "Turanian Stock: being a New Division of 'Social History of the Races of Mankind,'" by A. Featherman; "Free Exchange: Papers on Political and Economical Subjects," with an unpublished treatise on the law of value, and the unearned increment theory, by the late Right Hon. Sir Louis Mallet, C.B., edited by Bernard Mallet; "Socialism New and Old," by William Graham, professor of political economy and jurisprudence, Queen's College, Belfast; "On the Modification of Organisms," by David Syme; "General Physiology: a Physiological Theory of Cosmos," a rectification of the analytical concept of matter, and of the synthetical concept of bodies, resolving the problem of the unity of all objective knowledge, by Camilo Calleja, M.D.; "Theory of Physics: a Rectification of the Theories of Molar Mechanics, Heat, Chemistry, Sound, Light, and Electricity," by Camilo Calleja, M.D.; "Air Analysis: a Practical Treatise on the Examination of Air, with an Appendix on Illuminating-Gas," by J. Alfred Wanklyn and W. J. Cooper; "Soups and Stews and Choice Ragouts: Practical Cookery Recipes," prepared by Miss T. Cameron, diplomé National Training School of Cookery: "Afghan Poetry of the Seventeenth Century; being Selections from the Poems of Khush Hal Khan Khatak," with translations and grammatical introduction by C. E. Biddulph, M.A.; "Kahun, Gurob, and Hawara," by W. M. Flinders Petrie, with chapters by F. Ll. Griffith and Percy E. Newberry; "Arabic Chrestomathy," in Hebrew characters, with a glossary edited by Hartwig Hirschfeld, Ph.D.; "Bihari Proverbs," by John Christian.

—Messrs. E. & F. N. Spon announce that they have nearly ready a second edition, considerably enlarged, of Maycock's "Electrical Notes and Definitions," for the use of engineering students and practical men, with the rules and regulations to be observed in electrical installation work, as issued by the Phœnix Fire Office and the Institution of Electrical Engineers (with numerous illustrations, 32mo, roan, price $1.75).

—Messrs. William M. & J. C. Goldthwaite, New York, announce a new geographical magazine, embracing every thing in the geographical news line. Cyrus C. Adams of the New York *Sun*, is

to be the editor-in-chief. The first number will appear Jan. 1, 1891, and will contain "Great Glaciers of the Selkirks," by C. M. Skinner; "Progress of the Nicaragua Canal," by R. E. Peary, C.E., U.S.N.; "Americans in Tropical Africa," by Heli Chatelain; "Our Remaining Territories," by Cyrus C. Adams; "Methods of teaching Geography in Germany," by J. S. Keltie; "Arctic Exploration in 1891," by Cyrus C. Adams; "Railroad Pioneers in New Lands," by S. T. Jennings; "Hunting for Fossils on the Kongo," by G. E. Dupont; "Eskimo Maps," by Capt. G. Holm; "Victims of the Sultan of Morocco," by Albert Kirchoff; "How to popularize Geography," by George C. Hurlburt; "Our Geographical Progress;" "Work of the Geological Survey;" "The Exploration of Alaska;" "Young Folks' Geographical Corner;" "The Little Boys Stanley bought;" "First White Child in the Arctic Regions;" "Women Mountain-Climbers in 1890;" "Other Day, the Sioux Hero;" "Talk about Explorers, Discovery, and Books;" "Stanley's Criticisms on Map-Makers;" "Magazines devoted solely to Africa;" Reclus's Géographie Universelle and his Literary Methods;" "Denmark's Great Volumes on Greenland;" "Some Features of German Maps;" "The Geographical Exhibition of the Brooklyn Institute;" "New Boundary Lines in Africa;" "Buetthofer's Travels in Liberia;" "Tourist Routes in New Lands;" "Traces of the Lost Explorer, Leichhardt;" "New Islands in the Seas;" "Record of Geographical Progress."

—*Babyhood* for November contains an article on "Vegetables as Food for Young Children," by the medical editor, Dr. L. M. Yale. Of no less interest to young mothers is the article on the "Care of the Baby's Skin," by Dr. G. T. Jackson, the chief of the skin clinic at the New York College of Physicians and Surgeons. "Twice-Told Nursery Tales" is another medical article. The departments of "Occupations and Amusements," and the replies of the medical editor to the many questions asked by perplexed mothers, will be found very helpful.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—There being a considerable annual income for the purchase of books for the Museum Reference Library of Iowa College, it is desirable to have at hand any and all circulars, specimen sheets, catalogues, etc., of all works on Natural History in general, both foreign and domestic. Circulars of museum supplies, apparatus, etc., etc., desired also. State terms. Address ERWIN H. BARBOUR, Box 1333, Grinnell, Iowa.

WANTED.—A situation as Analytical Chemist is desired by the assistant of the late noted scientist, Dr. Cook, during his 15 years survey of the State of New Jersey. Highest testimonials furnished. Address Prof. EDWIN H. BOGARDUS, New Brunswick, P. O. Box 224, care Prof. F. C Van Dyck.

WANTED.—To purchase a complete set, or single numbers, of Loomis' contributions to meteorology, published in the *American Journal of Science*. Address communication, stating price, to FRANK WALDO, Mountain Lake Park, Garrett Co., Maryland.

COULD some one inform me what the ingredients and origin of asphalt as used for street-paving and gathered at Trinidad are? Also how gathered and shipped by natives, and mode of refining by the Warren-Scharf Co. of New York and the Barber Co. of Washington? G. KNIPER, 28 Gunn Block, Grand Rapids, Mich.

WANTED.—A position in a Normal School or College as teacher of Botany, Physiology, Zoology, Embryology, Chemistry, Physics, or German, by a university graduate who has done special work in the above lines. Several years' experience in teaching, and one year as assistant in Biology in a prominent university. Box 393, Greencastle, Ind.

PROFESSOR W. M. DAVIS, Harvard College, Cambridge, Mass., desires to correspond with professional and amateur photographers, from whom he can obtain views of New England landscapes.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I wish to exchange Eastern *Lepidoptera* for those that I do not have, particularly those found in the South. Jos. F. Crandall, Honesdale, Wayne Co., Pa.

To exchange, 1890 Seeger and Guernsey Cyclopedia, containing a complete list of the manufactures and products of the U. S., and address of first hands, cost $6. David R. Lewis, Saybrook, Ill.

For exchange—Nice specimens of Unios alatus, trigonus, parvus, occidens, anadontoides gibbosus, rectus, verucosus, gracilis coccineus, ventricasus, multiplicatus and plicatus cornutus. Margaritana confrogosa, complanata, rugosa. Anadonta edentula, decora, corpulenta, and about 300 of the beautiful Ana. suborbiculata. Wanted: Unios from all parts of the world, and sea-shells. Address Dr. W. S. Strode, Bernadotte, Ill.

For exchange—minerals and fossils, including ores, corals, Mazon Creek nodules for other minerals and fossils or historical relics. Tertiary specimens desirable. Address T. N. Glover, LockBox 19, Suffern, N. Y.

CALENDAR OF SOCIETIES.

Boston Society of Natural History.

Nov. 5. — G. H. Barton, Drumlins of Massachusetts; F. W. Putnam, Archæological Explorations in Ohio during the Past Season.

New York Academy of Sciences.

Nov. 3. — J. S. Newberry, On the Geological Age and Relations of the Potomac Group, of Virginia and Maryland (illustrated by specimens); Alexis A. Julien, On the Microbe of Phosphorescent Wood (illustrated by microscopic preparations).

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
VOL. XVI. No. 406.

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LIGHTHOUSE ILLUMINANTS.[1]

IT will be remembered that some years ago the Trinity House appointed a committee to carry out experiments at the South Foreland with a view of investigating the relative advantages of oil, gas, and electricity as lighthouse illuminants. Three experimental towers were erected, and were appropriated respectively to electricity, to Mr. Wigham's gas apparatus, and to oil, with occasional gaslights. Each lighting system was adapted to be shown in the multiform arrangement; i.e., with lights placed vertically one above the other. For gas, provision was made for showing four lights, while the electric and oil systems had three lights each. Observers were placed in huts at distances of 2,144 feet, 6,200 feet, and 2½ miles. For observations at greater distances, advantage was taken of the services of the coast-guard between the North Foreland and Dover; of the light-men on the "Gull," the "Goodwin," and the "Varne" lightships; of the lighthouse-keeper at the North Foreland; of pilots and masters navigating in the vicinity; and of the Elder Brethren and their officers. More than six thousand observations were taken. The conclusions arrived at were, (1) that the electric light was the most powerful under all conditions; (2) that the quadriform gas apparatus and the triform oil apparatus were of about the same power when seen through revolving lenses, the gas being "a little better" than the oil; (3) that through fixed lenses the superiority of the gaslight was unquestionable (the large size of the flames and their nearness together gave the beam a more compact appearance); (4) that the Douglass gas-burner was more efficient than the Wigham burner; (5) that for the ordinary necessities of lighthouse illumination mineral oil was the most suitable and economical illuminant, and that for salient headlands, important landfalls, and places where a very powerful light was required, electricity offered the greatest advantages.

This report did not please the advocates of gas. Memorials were poured into the Board of Trade from ship-owners, both individuals and associated bodies, asking that the experiments might be continued with duplicated gas apparatus of Wigham's pattern, this being understood to give greatly increased brilliancy. The board replied that they were informed that these experiments would cost £18,000, in addition to the £9,000 already spent, and that the state of the Mercantile Marine Fund would not allow of such an expenditure. Mr. Wigham characterized the estimate as "monstrous," and subsequently undertook to guarantee the expense should not exceed £2,000, if the existing apparatus were used, and the services of the various employees given. The Trinity House replied that a great deal of the apparatus had been put into actual service elsewhere, and that Mr. Wigham had ignored the expense of establishing multiform oil and electric lights in comparison with his multiform gas-lights.

Another objection brought against the report was that the final conclusion of the Trinity House ignoring gas was not justified by the record in the report itself. It was therefore urged upon the board that the report should be remitted to some independent scientific authority to determine if the evidence bore out the conclusions. Eventually this course was adopted, and the report sent to Sir George Stokes, president of the Royal Society, who associated with himself Lord Rayleigh and Sir William Thomson. These gentlemen have now reported to the Board of Trade at very considerable length, and, while their conclusions bear out to a large extent those arrived at by the Trinity House, yet they are distinctly more favorable to gas. They admit that it was quite natural that the splendid lights erected on the Wigham system on some parts of the Irish coast should have raised in the minds of ship-owners a feeling in their favor; but they point out that the question at issue does not relate to what has been done in the past, but that it is, "Does gas possess such advantages over oil as to outweigh the greater simplicity and economy of the latter illuminant, and should both, in the case of lights of special importance, be abandoned in favor of electricity?"

The 108-jet gas-burner gives a broader flame than the 6-wick oil-burner; and with lenses of similar apertures and focal lengths, and equal velocities of rotation, the diverging beam from the gas is of longer duration. This has been taken advantage of by Mr. Wigham for the introduction of a group flashing system, by which it is sought to give each light a distinctive character. The report states, however, that with revolving lights the number of flashes in a group is somewhat uncertain; with fixed lights there is no such uncertainty. The intermittence of a revolving light is obtained very sharply and suddenly, by turning the gas completely out, and by relighting it with a burst, resulting from allowing the gas to flow for an appreciable time before the flame is applied. With oil, intermittence can only be obtained by means of shutters, as it is not feasible to turn the light out. When the Wigham burner was compared with the Douglass burner, it was found that the latter gave the more light for a given consumption of gas. The smaller size of the flame also augmented the brightness of the flash. The Douglass burner, however, requires a glass chimney, which may give

[1] From Engineering of Oct. 31.

way, particularly if the flame be turned up rapidly under a sudden fog.

The electric-light apparatus far exceeded the others in the amount of light it gave out. Even in fog and haze it surpassed them; for, although the highly refrangible rays were rapidly dispersed, yet the remaining beam was not more cut down than that from gas or oil, and still maintained its superiority. This great power partly results from the smallness of the luminous area. The high condensation is obtained at the expense of the angular opening of the transmitted beam, which is less than with the taller flames of gas and oil. In practice the upper portion of the full beam must reach the horizon, as seen from the lantern of the lighthouse, while the lower portion must strike the sea at a moderate distance from its foot. It does not appear whether the electric beam employed would have fulfilled both these conditions. If it would not,—and the necessity of adjusting the carbons in certain cases to bring the full beam on to the observers suggests that it would not,—a deduction must be made from its value. Electric lights are practically reserved for revolving lights, the chief object of which is to guide the mariner from long distances. Fixed lights do not need the same far-reaching brilliancy, and it was abundantly proved that for these the gas-burners surpassed the oil-burners employed. Further, gas yields itself with special facility to conferring on a fixed light a distinctive character by means of intermittence.

All the points of difference that we have noted are clearly set forth in the reports, and little difference of opinion exists concerning them. But the advocates of gas claimed for it a special quality; namely, that of diffusing a warning glow through a fog at a distance beyond which the light could be actually seen itself. Sir George Stokes and his colleagues do not profess themselves able to decide whether the extension of distance at which warning will be conveyed by the glow from a gas or other light is such as to be of practical importance. They, however, make some general remarks on the subject, pointing out that the glow or burr is mainly produced by light which has been diffracted, and retains an approximation to its primitive direction. It is deflected from its course by an angle which is not by any means very small, and therefore it cannot matter much whether the regular light from which it originally came was concentrated by the lens within a more or less small angle. The *fog illuminating* power must depend mainly on the quantity of light sent out from the source, while the *fog penetrating* power depends on the concentration of the beam. It follows that the fog illuminating power of the electric light will be much smaller, in proportion to its power for direct penetration, than would be the case with oil, and still more with gas. Conversely, the glow from gas will extend farther beyond the limits of direct penetration of the beam than will the glow from oil, and still more than the glow from electric light. In light fog the direct light would probably be seen first; and, even if it were not, the slight extension of distance resulting from the glow would be of little value. But if the fog were comparatively thick, the ship must approach nearer to the lighthouse, where the illumination of the fog would be stronger, and the luminosity would be seen well before the actual light. This would be rendered more distinguishable from a thinning of the fog if the light was rapidly extinguished and relighted. In the second part of the report Sir Leopold McClintock speaks of "a striking, thrilling effect, which at once caught the eye," produced by cutting off the gas every few seconds. No opportunities, however, occurred for properly estimating the value of this effect, and it could not be taken into consideration in summing up the results of the experiments.

In reviewing the conclusions of the Trinity House committee, Sir George and his colleagues do not propose any serious modifications as to the first four points. (1) They consider the experiments established the superiority of the electric light, as exhibited at the South Foreland, under all conditions of weather. (2) They indorse the statement made as to the relative efficiency of gas and oil for revolving lights. (3) With the fixed lenses they attribute the superiority of gas chiefly to the fact, that, as the light is condensed by the optical apparatus in vertical planes only, the inferiority of the oil-light, as regards the initial quantity emitted, is not compensated for, as with annular lenses, by its superior condensation arising from the smaller width of the flame. (4) While admitting that the photometric measurements establish the superiority of the Douglass over the Wigham burners, as regards economy and efficiency arising from greater concentration of light, they state they have no information as to whether the employment of glass chimneys forms any serious drawbacks. It was the fifth recommendation of the original report that was most strenuously objected to by the advocates of gas, since it practically rejected that illuminant. It is now somewhat modified in form, and the use of gas is referred to, although scarcely recommended. We are now told, (5) "Though gas possesses undoubted advantages over oil in some respects, such as facility in increasing the power on the sudden occurrence of a fog, absence of the necessity of trimming, power of making instantaneous transition from light to darkness, and conversely, we do not think these advantages sufficient to outweigh the advantages which mineral oil possesses for ordinary employment on account of its simplicity and economy. We think, too, that for specially important sea-lights the experiments show that electricity offers the greatest advantages. At the same time, we see no reason for confining the choice to these two alternatives; nor does it appear that the words of the report so confine it. There may be special reasons in particular cases for giving the preference to gas, and it seems even desirable that mariners should have the opportunity of witnessing the effects of different systems, which would thereby be subjected to the test of long continued practical experience." As to the latter part, mariners have long had the opportunity of witnessing the effects of different systems, for several splendid gaslights are to be seen on the Irish coast, while there are electric lights on different parts of the coasts of Britain. Oil-lights, of course, are common enough.

It is not altogether to be wondered at that the Trinity House is disinclined to adopt gas in the present impoverished state of the Mercantile Marine Fund. In the days when that fund was overflowing they could have done so with ease, but now they have only a limited sum to spend on lighting our coasts, and therefore have to make it go as far as possible. The addition of a gas-making plant to a lighthouse means a considerable initial expense, and possibly an increase of working charges. During foggy weather the

light may have to be kept on for several days, and, unless the storage capacity were great, a man would be required specially to work the retorts. Now, since oil-burners are pronounced practically equal to gas for revolving lights, while for fixed lights a great power is not required, it is probably better economy to multiply lighthouses than to increase the outlay on those existing. Besides, the limit of the power of oil-lamps has certainly not yet been reached, and, urged by the rivalry of gas, it is certain that we shall get more powerful burners. Even before the South Foreland experiments were concluded, new and more effective types of burners had been constructed. In places where both light and power are required, as at Ailsa Craig, where there are siren fog-signals in addition to the lighthouse, gas is pretty certain to be adopted in the future, as it simplifies the attendance on the light, and is always at hand to start the air-compressing machinery in case of sudden fog. The production of gas by the distillation of petroleum is so simple that it can easily be learned by the class of attendants employed in lighthouses, and does not sensibly increase the chance of a break-down. It is a pity that the most interesting quality of gas-illumination, that of sky-flashing, was not more fully investigated. This seems to be full of promise. Often the thickness of a fog, measured vertically, is very small, and an intermittent light projected on to the sky could be readily seen. Every one knows how the attention is caught by sheet or summer lightning, in which the arch of the sky is momentarily lit up by a flash which is below the horizon, and therefore out of the range of direct vision. Even if the observer have his back to it, he can scarcely fail to see it. According to Sir L. McClintock, something of the same effect can be produced by a sudden burst of flame, produced by turning gas on for a moment before it is lighted. The condition of a mariner groping his way up channel in a thick fog is so dangerous that every expedient that promises to aid him is worth investigation. There are sufficient lighthouses where gas is used to enable this to be tried with scarcely any expense.

THE ARMY-WORM IN MARYLAND.

IN accordance with Professor Riley's instructions, on May 31, accompanied by Mr. Albert I. Hayward of the Maryland Agricultural College, Mr. William H. Ashmead started for Salisbury, Wicomico County, and Princess Anne, Somerset County, Md., to make such observations on the army-worm (*Leucania unipuncta*), then depredating in the vicinity of these places, as the limited time at their disposal should permit.

During the journey (reported in the September bulletin of the United States Department of Agriculture) they ascertained in conversation that the worms were most numerous in the immediate vicinity of Princess Anne, and so they took the most direct route for that place.

As they approached their destination they began to see the effects of the worms' work. Just before entering the town, they passed by a large field of corn, owned by Mr. H. H. Deshields, containing about twelve acres, that had been devastated by the army-worm, and only a few green plants could be detected here and there in the field.

This field was in marked contrast with another corn-field adjacent, which had been saved from attacks by ditching, as recommended in the "Third Report of the United States Entomological Commission." Another thing observed was that this field was flanked behind with a wood that evidently prevented their ingress that way, whereas the former was contiguous to grass and wheat fields, in which the worms are said to originate.

Just before entering the town, another ten-acre corn-field was passed, owned by Mr. John L. Lormer, that but a short time previously presented a most promising appearance, but which is now completely "cleaned out" by the worms. It may be worthy of record, as the theory has been advanced that insects originate in just such places, that in an adjoining field were three old haystacks. Contrary to their expectations, they found the reports of their numbers not at all exaggerated; and the damage done is even worse than was anticipated, the wheat, corn, barley, and timothy of many of the farmers being totally ruined by them.

One of the most interesting places for observation visited was that of William J. Porter, a practical and energetic farmer, who, although he has fought the worms most vigorously, has suffered severely from their attacks. By means of ditching and by burning straw, he has been able to save part of his crops; but several of his fields of corn, timothy, and wheat were already ruined. He reported the worms much less numerous than they had been, but there were many thousands seen in his fields.

During their rambles Mr. Porter took them to one of the ditches he had dug to keep the worms out of a large corn-field. In this ditch he had sunk, every two or three yards apart, deeper pits, where they found the worms two and three inches deep; and the rest of the ditch was black with the dead and living worms. From the dead a fearful stench arose in such strength as to attract the buzzards, which were proudly sailing overhead. Various carrion-beetles, too, seemed to revel in the carnage. Large silphids and staphylinids, besides numerous smaller forms, were quite numerous; while the hard-shelled histerids were quite plentiful, working through the putrid masses. Several carabids were observed running through the ditches, preying on the living and dying; *Scarites subterraneus* Fabr. being particularly noticeable, and no doubt, with its large mandibles, doing efficient service in destroying the worms.

Mr. Porter informed Messrs. Hayward and Ashmead that the worms always originated in the wheat and old grass fields, and during the morning hid themselves from observation, never appearing in numbers until after three o'clock P.M., which accorded with their own observations and with those of the other farmers visited.

They ate up the timothy and corn clean, and, after devouring the blades of the wheat, congregated, three or four together, on the heads. After devouring several of the lower grains, they ate the husks and nipped off the upper portion of the kernel of the rest, thus almost entirely destroying it. If the grain is well advanced and somewhat hard, it escapes destruction; but, as most of the wheat visited was still in the milk, the destruction was great, and not less than 75 per cent of the crop had been already destroyed.

Although several parasites are known to prey upon the worms, and a sharp lookout was kept for such, none were seen except a few cocoons of an *Apanteles*, which were discovered, together with the worms, under old trash and logs in a wheat-field. A few were gathered and forwarded to the Department of Agriculture, some of which have since hatched, and prove to be *Apanteles militaris* Walsh.

The corn-fields of all this region were found to be badly infested with the larvæ of two species of beetles; and so numerous are they at times as to entirely destroy the first planting, and necessitate a replanting of entire fields. The farmers call them the "bud-worm," and do not seem to be aware that they are two distinct species that do the injury.

One species is a well-known corn-pest, the larva of *Diabrotica vittata*, widely distributed over the United States; the other is one of the wire-worms, possibly the larva of a common beetle, *Drastarius elegans* Fabr., which also has an extended range, extending into Mexico. So far as known, this latter species has never before been reported as injurious to corn, as the larva is supposed to be predaceous on other insects. It may, though, have dual habits, not an unusual occurrence in some insects. Both of these species are more prevalent in low fields, the higher fields being less subject to their attacks.

Another beetle, found to be seriously injurious to cantaloupes and sweet-potatoes in this region was a chrysomelid, *Systena*

elongata Fabr., which was found swarming in numbers, skeletonizing the leaves, and frequently killing the young plants. Mr. Porter stated that he was compelled to replant on account of them.

On a neighboring farm, owned by Mr. Z. Rouch, almost as much damage had been done by the army-worm as on the former place. A large corn-field and a field of timothy were totally ruined. A wheat-field, further advanced than that of Mr. Porter's, was less seriously affected, although it did not escape entirely, the blades of the wheat and the young timothy being entirely eaten up by them. It was on this place that the effects of the worms on barley were seen. Quite a large field already in head was completely ruined.

In the afternoon probably the largest farm in the county was visited, that of the Hon. D. N. Dennis, comprising five hundred acres or more. No better place existed for the proper study of the pest, as the worms were swarming in all the fields by the millions, and it was just the proper time of day to see them most advantageously, four o'clock P.M. The ground was literally black with the crawling worms. Mr. Dennis had made no especial efforts to destroy them, although, like some of his neighbors, he had surrounded some of his fields with ditches in an attempt to keep them out of adjoining fields. It is believed that it would have been quite practicable to have destroyed many thousands with poisonous washes, or, as Mr. Porter did, by burning straw in the ditches, as the bottom of the ditches were black with worms.

This farm is divided by a central lane, on either side of which are fields of wheat, corn, grass, oats, etc.; and in passing through this lane the worms were found quite plentiful, crawling almost invariably in the direction of the prevailing wind.

One of the first fields passed was an immense wheat-field already in the head, and the worms could be plainly discernible on the ground all through it and on the stalks and heads. The worms, having already devoured the young timothy and other tender plants usually found growing there, the blades of the wheat, the husks, and a goodly portion of the kernels, evidently could not find sufficient food, and were now migrating to pastures new, the sides of the field being black with moving hosts seeking more nutritious food.

These, as well as all the others observed, were moving in a southwesterly direction,—the direction of the prevailing wind. They were apparently in all stages of growth, from little fellows not more than a quarter of an inch long, to the fully matured larvæ, and all got over the ground and every obstacle in their way with the most surprising rapidity. The fences, posts, and other obstacles in their way were no obstruction to their migratory instinct or their search for food. The fence-rails and posts were often covered with crawling worms, sometimes not less than a dozen worms being found on the top of a single tall post, while others were seen going up one side as others were going down the opposite. Some specimens were even found under the loose bark on the posts and rails, where they had probably crept for shelter. One specimen thus found was in the jaws of a large hairy spider, *Salticus* sp.

Adjacent to this wheat-field was a large field of timothy, containing seventeen acres, the blades of which had been cut off by the worms as clean as cattle could have done. Mr. Jones, the overseer, said that this field would have harvested not less than three tons of hay to the acre, but that now it would not pay for the cutting.

At one side of this field, the side next the wheat, the worms had congregated in countless numbers, every square foot having not less than thirty to fifty worms. The worms were now coming out of this field and going into the adjoining wheat-field, and crossing the lane into the opposite fields in great numbers; and it was here that a flock of the common English sparrows, and a few robins picking out the smaller worms and feeding on them, were observed. Mr. Jones said that the English sparrows had been thus busily engaged for a whole week, and it is a pleasure to record here this fact in favor of the despised bird.

Some distance off from this field was another one of wheat, containing probably twenty acres, in which the worms were even more numerous; and they had already sufficiently injured it to render the crop unprofitable to harvest. A deep, broad ditch had been dug along one side, and it was now, about five o'clock P.M., black with worms. It seemed a pity that these worms were not killed, as many of them were able to crawl up the sides, and escape into adjoining fields

Facing this field was a large corn-field of probably seventy-five acres, of which fifty acres had already been destroyed; and there was but a slight chance that any of the corn still left would escape, although by ditching an effort was being made to save it. Of the fifty acres destroyed, thirty acres had already been replanted; and in the newly ploughed portion the worms were seen moving about in all directions, having just entered it from the adjoining wheat. It is probable that most of these will die of starvation or from the effects of the hot sun in the middle of the day.

Messrs. Hayward and Ashmead were particularly struck with what Professor Riley has written about the army-worm not feeding on clover. Of the several clover-fields they saw, the worms passed entirely through them, eating the timothy, other grasses, and some weeds, but leaving the clover almost untouched. A few of the leaves and some of the heads were slightly eaten, but no appreciable injury was observed. Only once did they actually observe a worm eating it, and that was a single half grown specimen curled up on the head, devouring the most palatable portions.

The present outbreak seems to be quite local, within a radius of ten to fifteen miles; and of the origin and previous outbreaks but little was ascertained. All the farmers and others interviewed concurred in the opinion that the winter of 1889–90 had been unusually mild and dry, and a few reported having observed the worms feeding on warm days during the winter.

On the following day they visited Salisbury, but found nothing of importance to prolong their stay there. Messrs. L. Malone and W. B. Tighlman said that the army-worm had not as yet appeared on any of the farms in the immediate vicinity, and no serious injury had been done nearer than three miles.

Mr. Tighlman reported the oat-crop of this whole region this year a total failure from the depredations of the grain aphis, *Siphonophora avenæ* Fabr.

WHEAT-SMUT.

THE August Bulletin of the Kansas Experiment Station contains the report of an exhaustive experiment in the prevention of the stinking-smut of wheat, the results of which are so valuable that they should have the widest possible dissemination.

It is a well-known fact that smut and similar growths are due to parasitic fungi, which propagate by spores (similar to seeds of other plants); these spores being, in the case of wheat-smut, the black stinking-powder that is found inside the smutted grains. In threshing, these grains are broken, and the spores are scattered over healthy grains, with which they are planted and on which they take root and grow, sending up in the issues of the young plant microscopic threads, which grow with its growth; and when the wheat heads out, they penetrate the grains, and there absorb the nutriment intended for the grain, and convert it into the fetid smut.

Knowing this history of the smut, it is easy to understand that any treatment that will kill the spores of the smut on the seed-grain will reduce the injury to the following crop. It has long been known that this might be accomplished by soaking the seed-grain in solution of sulphate of copper (blue vitriol), but this process has the disadvantage of injuring the vitality of the seed-grain. The Kansas experiment was undertaken with a view of ascertaining whether the desired object might be accomplished without this injury. In this experiment fifty-one different methods of treatment were employed. Some killed the grain as well as smut; some did little or no good. The most effective treatment was found to be simply scalding the seed,—a method first published by J. L. Jensen of Denmark.

To accomplish this, the seed should be handled in loose baskets, such as will permit the water to pass readily through them. It should first be dipped in water warmed to from 110° to 120°,

otherwise the scalding water will be cooled too much; then dip it in a large vessel containing water heated to not less than 132° and not exceeding 135°. Shake or stir it thoroughly, so that the water will reach every grain. Remove the basket occasionally, and add boiling water until the temperature is brought up to the proper point. Keep it in hot water fifteen minutes, then spread out to dry. If this work is thoroughly done, the smut-spores will be destroyed without any injury to the wheat.

DRIED BREWERS' GRAINS.

THE dairymen of our larger cities and towns who live in the neighborhood of large brewing establishments have long recognized refuse brewers' grains as excellent food for milch cattle.

In brewing, says Mr. William Frear, in Bulletin No. 12 of the Pennsylvania State College Agricultural Experiment Station, the barley is first started to germinating, by which most of the starch is changed to maltose, a soluble compound related to sugar. At the proper stage germination is arrested by drying the grains; and the sprouts, which would impart undesirable qualities to the "wort," are removed by stirring and screening. The maltose is then extracted from the grain by hot water to form the wort, or liquid in which alcoholic fermentation is to be set up. The grain left after the wort is drawn off is known as "brewers' grains."

It is a very watery material, expensive to carry great distances, and difficult to preserve, being highly fermentable. Since, however, it contains nearly all of the nitrogenous matter of the original grain, with a much smaller percentage of starch, it forms, in spite of its watery condition, a very important cattle-food.

It has heretofore been found difficult to dry it economically, so as to make its preservation and transportation possible. Recently the Pabst Brewing Company of Milwaukee, Wis., have dried the grain at a low temperature by means of a vacuum process, and without the removal of the last traces of wort by pressure.

An analysis shows that out of the 21.50 per cent of proteine, 17.44 per cent consists of true albuminoids. Careful tests showed no traces of sugar left in the grains, and only 3.17 per cent of starch.

In composition it lies, in most respects, between linseed-meal and wheat-bran, save that it has nearly twice as much fibre. Malt sprouts are somewhat more highly nitrogenous, and contain only about half as much fibre, but they contain only one-ninth as much fat, which, in this case, is probably very largely digestible and of high nutritive value.

If placed upon the market at such a price as to compete with other foods of its class, it will undoubtedly, according to Mr. Frear, prove a valuable addition to the list of highly nitrogenous by-products useful as cattle-foods.

NOTES AND NEWS.

THERE is some difference of opinion as to the original meaning of the word "kangaroo." At the meeting of the Linnean Society of New South Wales on Aug. 27, says *Nature*, the question was discussed, whether, in the dialect of the blacks of the Endeavour River, the word signified "I don't know," and was so used in answer to the queries of Capt. Cook's party, or whether, as Cook supposed, it really was the name of the animal in use among the aborigines of the locality.

—Mr. Cecil Carus-Wilson writes to *Nature* that he has invented a luminous crayon for the purpose of enabling lecturers to draw on the blackboard when the room is darkened for the use of the lantern. He hopes that the invention may prove of value not only to lecturers who use a lantern, but also (in another form) to those students who wish to take notes.

—In a long series of articles a native Japanese paper gives some interesting figures about the students of Tokio (republished in *Nature*). There are 107,312 students in the whole empire in the various colleges and other high schools (primary schools and ordinary middle schools excepted). Of this number, 38,114 represent students prosecuting their studies in the capital; that is to say, about 40 per cent of the whole number are congregated in Tokio. Among the 38,114 students, 6,899 are domiciled in Tokio, so that the number of those coming from other localities is 31,215. The amounts which individual students spend vary from $7 or $8 to about $15 per month. Taking the average, it may be assumed that each student spends $10 a month, or $120 a year. Thus the total amount of money annually disbursed by these lads is a little over $3,700,000. In other words, money aggregating over three millions and a half is being yearly drawn from the provinces to the capital through this channel. The provinces receive little in return, for few of the students ever go back to their homes, their sole ambition being to remain in the capital, and there rise to eminence in some walk of life.

—Since the preparation of the article by Professor Angelo Heilprin in *Science* of Nov. 7, Mr. Israel C. Russell has made a preliminary report on his researches (in conjunction with Mr. Kerr) in the St. Elias region,—researches undertaken under the auspices of the National Geographic Society. The measurements of Kerr, as reported at length in some of the daily papers, give for the height of St. Elias *less than* 15,000 feet, which thus places Orizaba pre-eminently to the first place among North American mountains.

—At a meeting of the executive committee of the National Electric Light Association held at the Electric Club, New York City, Nov. 7, the date for holding the thirteenth convention was fixed for Feb. 17, 18, and 19, 1891. Eugene F. Phillips of Providence, where the convention will be held, was appointed chairman of a committee of five, on reception and arrangements, he to appoint the other members of the committee. Gen. C. H. Barney of New York was appointed chairman of a committee of three on electrical exhibits and transportation, he to appoint the other members of the committee. The committee on papers reported the following as promised, and stated that the prospects of securing two or three more important papers are most excellent (announcements of these will be made later): "How can the National Electric Light Association best serve Central Station Interests?" by C. R. Huntley, discussion by A. M. Young; "Distribution of Steam from a Central Station," by F. H. Prentiss, discussion by George H. Babcock; "Distribution and Care of Alternating Currents," by T. Carpenter Smith, discussion by G. H. Blaxter; "Municipal Control of Electric Railroads," by M. W. Mead, discussion by M. J. Francisco; "The Ferranti System," by C. B. Haskins, discussion by C. L. Edgar. The committee has not only secured the promise of these papers, but has gone a step further, and named a person to open the discussion on each paper. This must inevitably tend to bring out the best points of the topic, and to greatly add to the interest in and value of the proceedings.

—If we were to judge by statistics alone, says *Nature* of Oct. 16, we should be forced to conclude that the present system of granting rewards for the destruction of wild animals in India has had little or no effect in diminishing their numbers or in decreasing the mortality caused by them. This conclusion, however, would not be in accordance with facts. The methods according to which the statistics are collected have been so much improved, that no deduction can safely be made from the figures available. This is pointed out in a recent report of the Revenue Department of the Government of Madras. The report continues, "The experience of almost every district officer who has been some years in the country would be that the number of destructive wild animals had largely decreased with the advance of cultivation and the progress of railways, and the evidence of natives would probably be the same. There are parts of the country still, where, owing to the existence of forest and difficulty of access, wild animals of prey continue to exist in large numbers; and it is the case, that, owing to various causes, Europeans, at all events, do less now in the way of killing large game than formerly was the case. They have less time to spare from their official duties, and less money to spend. It can hardly, however, be doubted, that, owing to the existence of the system of granting rewards for animals slain, native shikaris are encouraged to maintain a profession which otherwise probably they would give up from want of support; and for this reason, if for no other, the board would not wish to see at present any change made in the system of granting re-

wards. It may be hoped that the construction of the East Coast Railway, and the branch from it through the heart of the Vizagapatam district to the Central Provinces, will tend in a great measure to reduce the number of wild animals in the districts where they now do very considerable damage. Cultivation and population in tracts now given up to jungle and grass will increase largely, and the need of wood for the railways will lead probably to the destruction of large areas of jungles, which now exist in tracts which should be devoted to agriculture."

— The Cornell University Experiment Station has made a series of experiments in setting milk for cream-raising by different methods, the results of which, as summarized in Bulletin No. 20 of that station, are as follows: in eleven trials where the milk was set in the Cooley creamer with ice-water at a temperature of 44°, the average per cent of fat in the skim milk was .23; in eleven trials where milk was diluted with an equal weight of cold water, and set in the open air, the average per cent of fat in the skim milk was 1 38; in six trials where milk was diluted with 20 and 50 per cent of cold water, the average per cent of fat in the skim milk was 1.24; in ten trials where milk was diluted with 10 to 100 per cent of its weight of hot water, the average per cent of fat in the skim milk was 1.11; in two trials where milk was set in deep cans without dilution, in running water at 60° to 63°, the average per cent of fat in the skim milk was .89; in two trials where milk was set in shallow cans, at 60° and 64°, the average per cent of fat in the skim milk was .48; in one trial where milk was set in shallow pans, and one-third of its weight of water at 120° added, the per cent of fat in the skim milk was .75.

—Plans, and estimates of time and cost of construction, will be received by Professor R. H. Thurston, director of Sibley College, Cornell University, not later than Dec. 25, 1890, for an experimental steam-engine, such as is customarily made a part of the equipment of technical schools of the higher class, and used by them in researches in steam-engineering. This institution already has a number of engines adapted in various ways for this work; but it is desired that one should be there installed which shall present peculiar facilities for illustration, and for investigations in connection with the higher graduate courses of instruction, and in the schools of steam-engineering, of marine engineering and naval architecture, now making preparation for their work, and in the school of railway mechanical engineering which it is anticipated may be organized should the former prove useful and successful. Plans, and estimates of cost of construction and of time required, will be received also from builders of testing-machines not later than Dec. 25, certain conditions being prescribed.

— The Harveian oration was delivered by Dr. Andrew on Saturday, Oct. 18, at the Royal College of Physicians. In the course of the oration, as we learn from *Nature*, Dr. Andrew referred to the fact that the relationship between physiology and medicine has in many ways greatly changed during the last two hundred and fifty years, and that such change is a necessary consequence of the progress made by physiology. "The goal of physiology is truth, e.g., perfectly trustworthy knowledge of a certain class of facts and laws; and this independently of any use, good or bad, to which that knowledge may be put. The goal of medicine is power; e.g., ability to manipulate certain given forces in such fashion as to produce certain effects. No doubt theoretically the two ends coincide, and we may hope in some remote future they will do so in reality and perfectly. For the present we must be content with having in one direction much knowledge which confers little or no power, and, on another side, very imperfect knowledge which yet brings with it very great power, too often ill directed. Again, their methods are different. Physiology by slow degrees has come to rely more and more on purely scientific modes and instruments of research, and to apply them by preference to matters which can be brought to the test of direct experiment. Medicine, on the other hand, has no choice but to remain, so far as it has a scientific side, a science of observation; for any thing like effective investigation of the matters with which it deals by direct experiment is impossible. As physiology slowly reduces to order the apparently hopeless confusion of so-called vital actions, the easiest questions are attacked and answered first, and thus those which have to be faced later in their turn are more and more difficult, more and more refractory to scientific analysis. Now, these more difficult questions are often of vital importance to medicine, and in them lie dormant vast possibilities of increased knowledge of the nature of disease, of increased power over it. And yet, from the great difficulty of subjecting them to experiment, physiology may seem for a time to fail us, and the task of employing physiological results to explain clinical facts, or to form the basis of rational treatment, becomes harder than ever."

—In the great experiments of Sir John B. Lawes, which have been conducted on Rothamsted Farm for more than forty years, potash seems to have had no effect as a fertilizer for wheat, except when combined with both phosphoric acid and nitrogen. In the experiments now in progress at the Ohio Experiment Station, potash seems to have no effect on wheat, whether used alone or in any combination. At the experiment station of Kentucky (at Lexington), potash has produced a very marked increase of crop when used on corn, hemp, tobacco, and potatoes; but here, again, it fails to increase the yield of wheat, whether used alone or in combination, as indicated by experiments published in Bulletin No 30 of that station, for August, 1890. The Ohio and Kentucky experiments are as yet in their infancy; and it is probable, that, as the soil becomes more worn, even wheat will show some benefit from applications of potash; but the present indications are that this substance is seldom needed in fertilizers intended for this crop. It may be that the clover following the wheat will make good use of the potash, but this point should be determined by experiment, not by guess-work.

— In the numerous experiments in feeding hogs conducted at the Agricultural Experiment Station of the University of Wisconsin, where corn-meal was the exclusive feed for a considerable length of time, it has been found that the bones of animals so fed are less strong in breaking-tests than the bones from hogs receiving other feeds. The question naturally arose as to the ability of Indian-corn to supply ash material for building up strong frames in animals to which it was fed. Successful feeders and observing farmers have long recommended the use of charcoal and hard-wood ashes for hogs, especially during periods when large amounts of corn were fed. Their experience with weak bones, and the ideas held by feeders, led the station to experiments in which hard-wood ashes were fed to some hogs receiving corn, and withheld from others. Knowing that meal made from the bones of animals, usually used for fertilizer, contains large amounts of phosphorus and lime, it was deemed proper to feed this at the same time that ashes was being fed, in order to ascertain if it was superior to ashes. In the sixth report of this station, two experiments in this line are given. Desiring to settle the question more definitely, the work was continued, and report made of two additional experiments, with the following results: 1st, that the effect of the bone-meal and ashes was to save about 130 pounds of corn, or 28 per cent of the total amount fed in producing 100 pounds of gain, live weight; 2d, that by feeding the bone-meal the strength of the thigh bones was doubled, and ashes nearly doubled the strength of the bones; 3d, that there was about 50 per cent more ash in the bones of the hogs receiving bone-meal and hard-wood ashes than in the others.

— The "Listener" had a most curious thing happen to him not many nights ago, as he states in the *Boston Transcript* of Nov. 3. He was asleep, and dreamed persistently of a gentleman of his acquaintance whose name is Hale. Nothing in the events or changes of his dream could get this Mr. Hale out of the foreground: he was always there; he did not transform himself into anybody else; he did not do any thing in particular nor say any thing in particular; he was simply Mr. Hale, and seemed to be there solely for the purpose of being Mr. Hale, and enforcing his constant, steady, vivid personality on the presence of the dreamer. This went on for some little dream-space, and then the dreamer awoke. It was in the middle of the night. His first conscious thought or perception was that it was raining very hard on the zinc roof of the porch. The rain seemed to beat down with immense violence. He rose to close a window, thinking that the water would beat in. As he advanced toward the window, the

storm ceased suddenly. "Why," said the "Listener" to himself, "that was like the sudden ceasing of a hail-storm." A queer thought about the dream came to him. He lighted a lamp, and looked out upon the roof of the porch, and there were many little heaps of fast-melting hail-stones. Now, had the pelting of the *hail* upon the roof suggested that dream-presentation of the personality of Mr. *Hale?* Very likely it had. But by what process of consciousness? Evidently the dreaming consciousness or perception was superior to the waking consciousness; for, if the storm suggested the dream at all, the dreamer must have been aware that it was *hail* that was falling, in order that Mr. Hale should come forth; but, when he really woke from sleep into full consciousness, he took the storm for rain, and there was no thought of hail in his mind. It is a nut for the psychologists to crack, if they think it worth their while.

— During the month of August last, the Mediterranean fleet of the French Navy was supplied with a captive balloon for the purpose of reconnoitring. The balloon, according to *Engineering* of Oct. 24, was constructed at the military balloon works at Calais Meudon, and has a capacity of 11,300 cubic feet. It is inflated with hydrogen, which is carried in reservoirs under a pressure of 100 atmospheres. A tail-rope 130 feet long, which for lightness is best made of silk, serves to connect the balloon with a ship of the fleet. A number of ascents have been made with the balloon from the armor-clad "Formidable," the tail-rope being connected to the top of one of the military masts. Many officers of the vessel have made ascents, and are unanimous in their praise of the apparatus. On a clear day all important objects within a radius of eighteen to twenty-four miles can be clearly distinguished. Another important point is that the waters of the sea, when observed from a considerable altitude, are singularly clear, and the details of the bottom were in some of the ascents clearly distinguishable, even at depths of 80 feet. This peculiarity allowed an observer in the balloon to follow the movements of the submarine boat "Gymnote," during its recent trials, without losing sight of it for a single instant, whatever its depth of immersion. The balloons used are very stoutly constructed, and in September last one was towed at a speed of 10½ knots per hour for a distance of 21 knots by the torpedo-boat "Audacieux" without suffering the slightest damage. It may be remarked, in conclusion, that Germany has also adopted balloons for naval purposes, and, during the recent manœuvres at Wilhelmshaven, one of these was used from the war-ship "Mars" for reconnoitring.

— The first determination of the moon's mass was made by Newton in 1687, from the tides, and other investigators have since employed the same method, but for more than one hundred and eighty years it yielded no trustworthy result. Its failure was due to various causes, both theoretical and practical; and, although some of these were cleared up by La Place as early as 1818, there was little prospect of success until the recent application of harmonic analysis to the reduction of continuous observations of the tides, recorded by automatic gauges, and extending over long periods of time. Long ago Airy showed why the moon's mass cannot be accurately determined from the mere ratio of the solar and lunar effects in the semi mensual inequality of the tides; but nevertheless many of the values recorded have been obtained in that very way, and are therefore worthless. Those found by La-Place's method, or by Ferrel's modification of it, are theoretically correct, at least for deep-water tides; but, instead of confining himself to them, Professor William Harkness of the Naval Observatory, Washington, has computed many new values from the "Results of the Harmonic Analysis of Tidal Observations," which have been published by Major Baird and Professor Darwin. The final result of Professor Harkness's work is—

$$\text{Mass of Moon} = 0.012714 \pm 0.000222.$$

— A memorandum, together with a sample of the plant, lately received from Sir Alfred Moloney, the Governor of Lagos, says the *Journal of the Society of Arts* (London) of Oct. 24, gives an account of the endeavor he is making to encourage the exportation of the fibre known as "African bass,"—the fibre of the bamboo-palm (or *Raphia vinifera*). The bamboo-palm (*Raphia vinifera*) is perhaps the commonest tree in the swamps and lowlands which line the waterways of the colony. Dense thickets of these palms, traversed only by the palm wine-gatherer or the bamboo-cutter, push their way into the lagoons, and extend over the flood grounds, and even to a distance of from fifteen to twenty miles up the river-valleys into the interior. The area occupied by these *Raphia* forests it would be impossible to calculate; but it may be accepted without doubt that they extend throughout the length of the colony, and to a distance of at least fifteen miles from the seacoast, and that over this area of about five thousand square miles they form a considerable proportion of the vegetation, next only in numbers to the oil-palm (*Elaeis guineensis*) and the mangrove (*Rhizophora mucronata*). The fibre itself is the one in most common employment on the coast, being used by the natives for all sorts of purposes,—cloth, cordage, thatch, fishing-lines, etc. The cost is only that of collection and preparation, the latter being a very simple process of soaking and scraping. The price, delivered in England, is said to be from $150 to $160 per ton for good fibre. The cost of production is estimated at $70 per ton; shipping and other expenses, at $22.50.

— Some time since, Mr. Albert Koebele, the California agent of the Division of Entomology of the United States Agricultural Department, was instructed to collect and forward to Mr. Wight in New Zealand a number of living specimens of a common *Raphidia* which he had found to destroy the larva and pupa of the codling-moth in California. This was done as a partial return for Mr. Wight's kindness to Mr. Koebele when he was in New Zealand in the spring of 1889, collecting the insect enemies of the fluted scale. Recent letters from Mr. Wight, and an article in the June number of the *New Zealand Farmer*, state that the shipment arrived in fairly good condition, although it was opened for examination, and held for ten days, at the custom-house. Twenty-one specimens were sent, each one in a small box with moss, and the whole enclosed in a strong wooden box. Mr. Wight found pupæ in sixteen of the boxes, and a larva in one; while three were empty, probably owing to the custom-house examination. The single larva was hungry and very attenuated, and it at once attacked and devoured a codling-moth larva twice its own size. It was so stretched out and distended that at first, not discovering the absence of the codling moth larva, Mr. Wight thought it was entering the pupa state; but it presently resumed its usual appearance, and finished several more larvæ. The result of this importation is looked forward to with great interest. The genus *Raphidia* is represented in this country only upon the Pacific coast, and it is not at all likely that it will flourish East. An attempt, however, will be made to introduce this ravenous creature into some of our Eastern apple-orchards.

— Next to the cabbage-worm, the worst insect enemy of the cabbage is the aphis, or plant-louse, which is so often found upon the leaves and in the heads in great numbers. This is a small, bluish-white insect, that subsists upon the sap of the plant, and multiplies with great rapidity. Like most of the peculiar family to which it belongs, this insect has the power, not common among insects, of bringing forth living young; but with most of those that have been carefully studied there is in the fall a sexual generation by which the true eggs are laid, and in this egg state most of them pass the winter. But although the cabbage aphis has been known both in Europe and America for more than a century, the sexual generation has never heretofore been found, and entomologists did not know where or when the eggs were laid, nor how the insect passed the winter. Recent investigations, however, carried on at the Ohio Experiment Station by Dr. C. M. Werd, have shown conclusively that the sexual generation develops late in autumn on the cabbage, and that the eggs are laid on the cabbage-leaves. The true male is a small winged creature, with a more slender body than the other winged forms. The egg-laying female has no wings, and is pale green in color. This discovery of the fact that the insect passes the winter in the egg state on the cabbage-leaves has an important economic bearing. It suggests, as one of the best ways of preventing the injuries of this pest, the destruction during winter of the old cabbage-leaves with the eggs upon them, instead of leaving them undisturbed until spring, as is too often done.

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

HEALTH MATTERS.

Treatment of Consumption.

FROM the *Lancet* of Aug. 30 we learn that Koch's views on the treatment of *phthisis pulmonalis* have received interesting support from the experience of a chemist, Herr Reuter, made public in April last at a full meeting of the Lower Austrian Industrial Union. Koch, it will be remembered, maintained at the Berlin congress, that, among the remedies capable of bringing the malady to a standstill, the salts of gold and silver are of the greatest value, and that among these the first place must be given to "cyan-gold." Reuter, who, as director of the great *fabriques* of metallic wares at home and abroad, paid particular attention to those in which the articles in question were galvanically gilded or silvered, observed that in the latter industry the employees who had consumptive or tubercular symptoms, some indeed who suffered from hemoptysis, found marked relief in their work, and continued to improve so rapidly that in a few weeks their return to health was assured. The favorable impression made on Reuter as to the curative effects of the gold and silver industry on phthisis, he found confirmed by the testimony of employees of every age in these establishments; men, young and old, who had the well-known symptoms of pulmonary consumption, even at an advanced stage, rapidly getting well as they continued from week to week at work. Further investigations strengthened that impression still more, till he had satisfied himself that for the disease in question a healing virtue resides in the prussic acid generated particularly in those workshops where "cyan-metals" dissolved in "cyan-kalium" are used. Impressed by Koch's views, the Medical Association of Vienna has since bestowed special consideration on Reuter's experiences embodied in the paper read before the Lower Austrian Industrial Union last April, and, while admitting the confirmation given to those views by Reuter, it is of opinion that the honor of priority in discovering the efficacy of gold and silver salts in the treatment of *phthisis pulmonalis* belongs undoubtedly to the latter.

Medical Treatment of Fractures.

In a graduation thesis in Havana an author discusses the advantage of prescribing various forms of phosphorus for patients suffering from fracture. As given in the *Lancet*, he carried out a series of experiments on dogs and fowls by breaking the femur by means of an osteoclast, and putting up the limb in splints. He then divided the patients into two groups, the first group being treated with phosphorus in various forms, the second being left without medication. The result was that the callus was more abundant and firmer in animals treated with phosphide of zinc than in those treated with phosphate of lime or than in those not treated at all. These results were confirmed by observations made in the surgical wards, where it was found that patients with fractures who took from a quarter to an eighth of a grain of phosphide of zinc daily made exceptionally good and rapid recoveries. The only unpleasant effects produced by this treatment were that one out of the eighteen patients on whom it was tried suffered from slight diarrhœa, and in one the pulse became slow and hard.

The International Medical Congress at Rome.

Dr. Guido Baccelli, president of the Accademia Medica of Rome, and professor of clinical medicine at the Sapienza, took the chair at a recent meeting of the Società per il Bene Economico di Roma, to consider the means of insuring the success of the International Medical Congress to be held three years hence in the Eternal City. Among the adjuncts to that congress, as we learn from the *Lancet*, it was decided to form an international exposition of hygiene in connection with the sanitary department of the programme, and, with that object, to appeal to all the leading industrial and professional centres throughout the peninsula to contribute their best and latest additions to the "Armamentarium Hygienicum," so as to place Italy at as great an advantage as possible in the inevitable contrast between her own sanitary work and that of the other powers represented on the occasion. Florence, which has hitherto led the van in hygienic progress in Italy, has already promised her energetic co-operation; and other cities, like Turin and Milan, are expected to do likewise. Concurrently with the medical congress, an international exposition of the industries of all nations is also being organized; so that Rome will be the busy scene of quite a gathering of the peoples, on a scale she has not yet known since she ceased to be mistress of the world The early summer months (May or the beginning of June), or the early autumn months (the latter half of September or the beginning of October) are likely to be those selected for the medical congress, all risk of malaria at either time being improbable.

Color-Blindness among the Chinese.

Six hundred men and 600 women were examined by Dr. Thomson's stick of Berlin wool-tests. In this number, according to *The Medical Analectic and Epitome*, 20 color-blind were met (19 men and 1 woman). Of the 19 men, 13 were completely green-blind, 5 were completely red-blind, and 1 incompletely red-blind: the woman was completely green-blind. The 19 color-blind men were divided thus: 11 farmers, 2 teachers, 1 hospital assistant, 1 preacher, 1 mason, 1 boatman. There was almost a universal lack of discrimination between green and blue. The tests were not well adapted for proving what was suspected,—that many Chinese are violet blind.

Possible Dangers of Hypnotism.

As long ago as 1784 some of the dangers of hypnotism were pointed out by De Puységur, a pupil of Mesmer. The danger to which he referred more particularly was the criminal use which

an unprincipled person might make of the ascendancy gained over the subject. These warnings, frequently repeated, are not without reason, as the annals of crimes committed during the last sixty years abundantly prove.

But these are not the only sources of danger; for experience has abundantly shown that the subject himself may be prompted to commit theft and other species of crime after emerging from the hypnotic condition. This fact has become the subject of special judicial enactment in several countries.

Finally, the repeated hypnotization of the subject is liable to be followed by more or less dangerous consequences to himself. Inordinate emotionality, impairment of volition, and a tendency to become spontaneously hypnotized, or at least excessively drowsy, are some of the more obvious features of this post-hypnotic condition. Dr. J. Leonard Corning has at the present time under his care, as we learn from the *Medical Record* of Nov. 8, a gentleman who exhibits this neurosis—for neurosis it certainly is—in a striking manner. He is a man of rare gifts, he has maintained and still enjoys a high position in the community, and yet his mental decrepitude is so obvious that it is a matter of astonishment that he has been able to disguise its source so long. Currently he is regarded as a sufferer from mental overwork, and Dr. Corning confesses that he should have had great difficulty in arriving at the true nature of his difficulties, had the patient not confessed that he had been hypnotized scores of times, and that his present infirmity had come on as the direct result of these abuses, for abuses they certainly were.

Such a person as this is, of course, exposed to manifold dangers; for he had become so susceptible, that not only is it possible for any one to hypnotize him, but he is able without further assistance to induce in himself the sleep-like state.

Here, then, are the more manifest dangers of hyphotism.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Origin of Right-handedness.

PROFESSOR BALDWIN, in *Science* for Oct. 31, gives some interesting observations of his own on the development of right-handedness in an infant. He thinks the fact that the right hand began to be used in preference to the left only when the movement required an effort, is an argument in favor of those "feelings of innervation" whose existence many psychologists disbelieve, and challenges me (as a disbeliever) to explain the phenomena in any other way.

Why, asks Professor Baldwin, should the baby prefer her right hand for strong movements, unless previous experiences of using both hands had left behind them the sense that the nervous discharge that actuated the right one was stronger than that which actuated the left?

I admit that this is a possible way of explaining the facts; but yet, if a memory of the previous superior effectiveness of the right hand is what determines now the choice of it for these movements, it does not seem in any way clear that the memory in question need be of the *efferent* current of discharge (the printer has made Professor Baldwin say "afferent" instead of "efferent"). Why may it not be of the greater promptitude, security, and ease of the right hand's movement, as apprehended in an *afferent* way, during previous performances? Professor Baldwin gives no grounds for his rejection of this equally possible alternative. But to my mind it is by no means evident that memories of any sort of past performances play a part in the preference accorded to the right hand. On any theory we have to suppose antecedently to all memory a natural prepotency in the paths of discharge into the right arm. Professor Baldwin's own idea, that discharges into this arm leave images of their superior strength behind, implies that they *have* greater strength to begin with. Why, now, with this organic peculiarity, may they not also have greater readiness to discharge when the stimulus reaches a certain amount? He who conceives of the mechanism of all these early movements as in principle the same as that of reflex action, ought, if he bears in mind the extraordinarily elaborate way in which different stimuli are correlated in the organism with different paths of discharge, to have no difficulty in believing the nerves which ran down into the right arm to be, on the whole, the most permeable paths of exit from the brain of such currents as run in from objects offered to the baby at a certain distance off. Grasping at such objects was the sort of performance which Professor Baldwin seems most to have observed. It is obviously an instinctive or semi-reflex act; and I should much rather explain it directly by connate paths alone, than by connate paths *plus* memories *plus* choice, after Professor Baldwin's fashion.

I must therefore conclude that Professor Baldwin's observations fail, in my opinion, to throw any positive light at all on the vexed question of whether we feel our motor-nerve currents as they pass out of our brain. In themselves, however, these observations seem very interesting as showing how strong stimuli may produce more definitely localized re-actions than weaker ones. The baby grasped at bright colors with the right hand almost exclusively.

WILLIAM JAMES.

Harvard University, Nov. 5.

Mount St. Elias.

AS the National Geographic Society will shortly discuss the most recent observations on Mount St. Elias, with the full data of Messrs. Russell and Kerr as a basis, I have determined to refrain from taking any part in the newspaper discussion in regard to the height of this mountain or the respective value to be assigned to the different sets of observations due to different observers. This is the only scientific method to pursue; and it is due to those well qualified and energetic explorers that their results, when they are finally made known, should form the basis of discussion, rather than opinions, surmises, or guesses prior to their final computations. The only thing which can be definitely stated at present is that they are of the opinion that the mountain is lower than the height of late accepted for it, and the very rough preliminary computation of their observations appears to sustain this view. The weight to be assigned to their observations, and the final outcome of the revised computations, are matters for the future.

But the article by Professor Heilprin on the Mexican mountains, which you have reprinted (p. 260) under the title of the "Culminating Point of the North American Continent," no doubt unintentionally, but nevertheless seriously, misrepresents the methods by which my results of 1874 were arrived at; and, in the interest of a clear understanding of the subject, it is perhaps desirable that some of its fallacies should be pointed out.

Professor Heilprin is no geodesist, as his discussion of determinations of heights of over 17,000 feet, based on a single pocket aneroid barometer, is sufficient to show. A little inquiry in proper quarters would have made it clear to him that observations taken with such an instrument are far from determinative. If they happen to closely approach accuracy, it is merely accidental; and a range of 500 feet in the results would reflect in no way on the care of the observer or the known reputation of the instrument. They bear to the mercurial barometer much such a relation as sextant angles taken at sea for vertical heights do to those taken on land with a vertical circle or geodetic transit.

This want of familiarity with the subject has led Professor Heilprin into a singular misconception of the relative values of observations cited in my "Report on Mount St. Elias" printed in the "United States Coast Survey Report for 1875," and of the data which are given therein with absolute frankness and full detail.

In that report I aimed to embody every thing which might possess even an historic interest, and therefore printed results which I stated to be more or less unreliable for reasons which would be accepted by every competent judge of such matters. I stated that these results were not adopted by me nor incorporated into the work depending upon observations of a higher class. But

Professor Heilprin compares the irregularities of this bad material, denounced by me as bad, and concludes that it is good evidence for doubting the value of that which was considered to be more reliable. Such reasoning obviously affords only a *non sequitur*. I do not think any one who has passed laborious days and nights in the determination of angles by repetition and reversal will agree with Professor Heilprin that the system of "extracting averages" is "delusive;" and a reference to my report will show that it was a question of comparison of averages with a view to the weighing of methods with which, in that instance, I was concerned, which could hardly delude any one who chose to read what was printed on the pages before him. Averages may be made delusive, but not when used in this manner.

In conclusion, although the whole subject is one for experts and professional surveyors rather than others, I may summarize for those who are interested and unprofessional the main features of what was done in 1874 for the purpose of getting at the height of that unattainable peak.

In the determination of any height by triangulation, there are to be considered the character of the instruments, the distance of the peak, the vertical angle measured, and the refraction of the atmosphere, which distorts the line of sight and introduces an error, tolerably constant for high angles and short distances in ordinary latitudes, but irregular and sometimes very great in angles measured when the line of sight passes near the surface of the earth, especially for long distances and in high latitudes.

In the case of Mount St. Elias the distance depended upon a horizontal triangle observed from two astronomically determined stations, giving an astronomical base-line from which the lines converging on the peak were obtained by an astronomical azimuth. The value of such an intersection depends somewhat upon the size of the angle, which in this case was large, nearly 60°. The liability to error which very small angles of intersection may introduce was therefore measurably avoided.

The positions of the ends of the base-line were well determined. The circumstances of the observation made at sea were eminently favorable. The error of this position could hardly have exceeded three miles on the worst assumption; and the error of distance which this would produce in the base of the vertical triangle, upon which the height depended, was trifling. The instruments were first-class of their kind. The vertical angle measured, I venture to say, is beyond dispute. The uncertainty remaining, therefore, was in regard to the refraction,—a factor beyond our power to determine, and equally undetermined in all observations made to date.

However, the height of Mount Fairweather was tolerably well determined from positions near its base. We reasoned the error of refraction might be assumed to be the same for both mountains at the same moment, both being visible and not differing very greatly in their distance from our station. The difference between the height of Fairweather as measured from near its base, and that which we might obtain for it from our Port Mulgrave station, might be assumed to be due to refraction, and an analogous amount applied to the result for St. Elias as a correction for that unknown error. This was an assumption, of course, but a reasonable one, and was adopted.

The height of Mount St. Elias may very possibly be less than our results would show; but that they were likely to be correct within certain limits seemed probable, from the fact that angles measured by Malespina in the last century, the record of which is fortunately preserved, when computed with a corrected base-line in accordance with our observations for the position of the mountain, gave results approximating our own,—an apparent confirmation which was certainly impressive.

The outline of our proceedings is given, as above, in entirely untechnical language, but those who are professionally qualified to judge the character of such work are confidently invited to examine the report itself in the Coast Survey volume for 1875. This is somewhat amplified from the extra advance copies which were distributed before the publication of the volume. I make no pretence to the character of a geodetic expert, but the comparatively simple computations contained in this report were prepared and reviewed by those who are; and the error, if error there be in the results, is due to factors which were entirely independent of the observers or the computers, under the circumstances.

Smithsonian Institution, Washington, D.C., Nov. 11. WM. H. DALL.

Chalk from the Niobrara Cretaceous of Kansas.

REFERRING to Professor S. W. Williston's interesting communication in *Science* for Oct. 31, on microscopic organisms from the chalk of the Niobrara cretaceous of Kansas, I should suppose it to be highly probable that the forms met with by him are, as he supposes, coccoliths. Coccoliths are very abundant in, and sometimes form a notable proportion of, the calcareous parts of the Niobrara beds in Manitoba and in Nebraska, and are there associated with foraminifera and with rhabdoliths, to which latter class the slender, rod-like bodies, also noted by Professor Williston, may be referrible. Figures and a description of a number of varieties of coccoliths and rhabdoliths from the cretaceous of Manitoba may be found in the *Canadian Naturalist* for April, 1874 (p. 256). GEORGE M. DAWSON.

Geological Survey of Canada, Nov. 10.

BOOK-REVIEWS.

Races and Peoples. By DANIEL G. BRINTON. New York, N. D. C. Hodges. 8°. $1.75.

DR. BRINTON has undertaken the difficult task of presenting the whole vast field of anthropological science in a concise and readable form, and he has admirably succeeded in giving us a book that is attractive, and, in all its parts, suggestive. Therefore not only will it prove useful in making the public acquainted with the facts and some theories of ethnological science, but it will also incite the painstaking student to more thorough investigation of mooted questions, and open new vistas in many fields of research. Dr. Brinton's theories, even such as may not appear acceptable, are always full of ingenuity, and certainly worth the careful attention of anthropologists. The present book, notwithstanding the briefness with which necessarily all problems are treated, teems with new ideas and excellent critical remarks. In reviewing it, we must confine ourselves to selecting a few of the more important points. On the whole, we might wish that some still very doubtful theories to which the author adheres were not presented with quite as much assurance as finally settled.

The introductory chapter, on "The Physical Elements of Ethnography," strikes us least favorably. We think that not sufficient stress has been laid upon the great variations inside each race, and that too much is made of the peculiarities of the "lower" races, which in some respects might be called rather exaggerated human types than simian in character. The second chapter, "The Psychical Elements of Ethnography," is a succinct presentation of the chief causes governing the development of society. The author distinguishes associative and dispersive elements: the former including the social instinct, language, religion, and arts; the latter, the migratory and combative instincts. Dr. Brinton is inclined to consider the sexual instincts and the resulting parental and filial affections to be the prime cause of association, and rejects all theories based on promiscuity. The third chapter will be found full of interest, more particularly where the author sets forth his ideas regarding the development of man, as well as his classification of mankind. Although he knows how to present his views with much force, we cannot consider his description of the earliest stages more than an ingenious hypothesis, because we have so far no means of reconstructing the history of the period immediately after man had made his appearance. Dr. Brinton believes that mankind during the preglacial period was homogeneous, his industries paleolithic with simple implements, his migrations extensive, his language rudimentary. Such speculations can neither be proved nor disproved. Even the character of the glacial period, as described by Dr. Brinton, is largely hypothetical. He believes the migrations to have been limited at the time, the races to be living in fixed areas. It seems impossible to fix any period for these events which have certainly taken place at some time. The author's general ethnographic classification is based on physical characters. According to these, he distinguishes Eurafrican, Austafrican, Asian, American, and

insular and littoral peoples. These he divides into branches which are not very well defined, there being portions of a race separated geographically, linguistically, or otherwise, from other portions of the race. The branches are subdivided into linguistic stocks This system is open to the same objection which must be made to Fr. Müller's: it is neither physical nor linguistical; and these two classifications, being based on entirely distinct phenomena, cannot be made to agree. The rest of the book is devoted to the discussion of the various races. The author sees the primal home of the Eurafrican race in North Africa, whence he believes the Hamitic, Shemitic, and Aryan people derive their origin. The last he considers as a mixed race on account of the predominance of two distinct physical types. If we should apply this test to any of the better known peoples, we would have to class them among the mixed races. There is certainly no homogeneous variety of man in any part of the world. Therefore the reduction of the Aryan race to two prototypes seems somewhat doubtful. We cannot enter into the interesting sketch of the other races, but confine ourselves to the remark that the descriptions, though brief, are always striking and interesting. In a concluding chapter Dr. Brinton sums up a number of important problems,—those of acclimatization, race-mixture, and of the ultimate destiny of the races. The author emphasizes justly the close relations between ethnography and historical and political science. His work will undoubtedly greatly contribute to making this close connection better known and more thoroughly understood.

The Trees of Northeastern America. By CHARLES S. NEWHALL. New York, Putnam. 8°. $2.50.

FOR its purpose, this book is admirable. The plan of the author was excellent, and he has carried it out well. There are defects in the book; but, as they are more of omission than of commission, they may be passed over with scarce a mention. In simple fashion and almost untechnical language, the author describes our trees, from their foliage, bark, and general appearance, so that they may be readily identified by persons without even a smattering of botanical knowledge. The trees described include all the native trees of the northern United States east of the Mississippi, as well as those of Canada. Mention is also made of the more important of the introduced and naturalized species The work is so arranged that any given specimen can be readily found by help of a well-arranged guide. The author's chief authority for the geographical distribution of the different species is Sargent's report in the "Tenth Census;" and for the scientific nomenclature adopted, Mr. Newhall acknowledges his indebtedness to Professor N. L. Britton of Columbia College. The latter gentleman, in a brief prefatory note, says, "There is great need of such a popular work. It will do much good in supplying information to our people about some of the common things around them, and this in an attractive manner."

The method of using the book is as simple as can be desired. Provided with a leaf of the tree to be identified, the inquirer, by a brief inspection of the easily mastered guide, is referred to the pages containing a drawing of the leaf (and sometimes the fruit) and the name and description of the tree. Both the popular and the scientific names are given, together with some account of the uses of the tree, and its distribution. Photo-engravings of the leaves and fruit, instead of the somewhat crude outline drawings, would, we think, have been more in keeping with the excellent mechanical make-up of the book, and would have added much to its value.

The Antiquities of Tennessee. By GATES P. THRUSTON. Cincinnati, Robert Clarke, 1890.

THE present volume is an excellent *résumé* of the results of recent archæological investigations in Tennessee. It is amply illustrated by good photo-engravings and numerous sketches of well-selected specimens. Many of them do not differ essentially from the well-known types of this region; but others will be found to be of great interest; for instance, the tattooed face bowl (p. 94), and the image in clay showing an infant strapped to a cradle-board (p. 112). The descriptions of the finds are so full of new, valuable, and well-arranged matter, that they will repay a close study. The conclusions which the author draws from his studies seem to be in the main well founded. He justly emphasizes the fact that the finds show no evidence whatever of a culture of a stamp different from that of the North American Indians, more particularly from that of the southern Indians as described by early travellers. He is also right in laying stress upon the dissemination of culture among the inhabitants of pre-Columbian America, which entails transmission not only of arts and industries, but also of manufactures. While in the introductory chapter of his book he does not consider the culture of the mound-builders as much higher than that of the Indians shortly before they came into contact with the whites, it seems, that, while studying the specimens, the culture of the mound-builders appeared to the author of increasing value; so that in his concluding chapter he is inclined to assume a decline of culture during the period following the "stone grave time." We believe that this decline may have been somewhat overestimated by the author, but we fully agree with his opinion that the mound-builders of Tennessee were Indians, and that the relics do not belong to any great antiquity. The author assumes that the decline in culture came about by an invasion from the north of a race which he believes he can recognize in a number of dolichocephalic crania taken from the stone graves. This proof must be rejected, as it is founded on the theory that a race is homogeneous, while actually, even in long-isolated races, we must expect to find a great variety of forms. Unfortunately archæologists do not yet duly appreciate the importance of osteological collections, a few well-preserved skulls being all that are deemed worthy of preservation. Broken skulls, and particularly skeletons, ought to be preserved as well, as only a thorough investigation of *all* the remains of a race will lead to reliable conclusions. Physical anthropology does not consist of a few cranial measurements, but is a detailed study in comparative osteology of man.

AMONG THE PUBLISHERS.

THE *Jenness-Miller Magazine* for November contains another article on "Physical Culture," by Miss Mabel Jenness; and "Temperance in Food," by Burcham Harding.

—Among the interesting exhibits at the American Institute Fair in this city is a handsome showcase filled with samples of the books published by E. & F. N. Spon of this city and London.

—A new edition of No. 57 of Van Nostrand's Science Series ("Incandescent Electric Lighting") has just been issued. New papers, by L. H. Latimer and C. J. Field, take the place of those by Du Moncel and Preece in the former edition, bringing the work more nearly to date.

—Vol. IV. No. 7 of the "Studies from the Biological Laboratory" of Johns Hopkins University, Baltimore, contains two articles,—one, "Notes on the Anatomy of Sipunculus Gouldii Pourtâles," by E. A. Andrews (with plates); and the other, "The Relationships of Arthropods," by H. T. Fernald (with plates).

—The Leonard Scott Publication Company, New York, announce that beginning with the November number they will in the future furnish their subscribers with the original Edinburgh edition of *Blackwood's Magazine*, printed in Edinburgh, and published by them here under authority of Messrs. William Blackwood & Son.

—The *Illustrated American* makes an offer in our advertising columns which may prove attractive to some of our readers. This weekly has certainly contained much interesting matter, unusually well illustrated, concerning the goings-on in the world, in which intelligent people are interested, and it is only to be regretted that in the recent numbers certain criminal affairs have been made prominent and served up in a style likely to entrap the unsuspecting reader into their perusal. The periodical is a new one, and deserves a careful examination at the hands of the reading public.

—Messrs. Houghton, Mifflin, & Co. have published a small volume entitled "Thoreau's Thoughts," consisting of brief passages selected from Thoreau's various writings by H. G. O. Blake. The selections seem to have been made with good judgment, except that they are too short. The editor has not included many of those passages descriptive of natural objects that so abound in

his author's works, but has confined himself in the main to thoughts on moral topics, such as study, society and solitude, friendship, and others of the like nature; and in this we think he has done wisely, for such ethical sayings are the most likely to do good. We cannot say, however, that we find much depth or originality in Thoreau's thinking, and we doubt if he has had much real influence even over his admirers.

—A neat and useful pocket manual for army officers is "Notes on Military Hygiene," by Lieut.-Col. Alfred A. Woodhull, which has recently been published by John Wiley & Sons. The little volume contains what may be called the essence of a series of lectures on military hygiene, delivered by the author at the Infantry and Cavalry School at Fort Leavenworth. Though originally prepared for the convenience of students, the work will no doubt prove acceptable to officers of the line generally. Among the topics discussed are the selection of soldiers, military clothing, food, habitations, camps and marches, sewers and waste, water, and preventable diseases.

—Messrs. Houghton, Mifflin, & Co. have just issued another volume (Vol. 34) of their Modern Classics,—a series which Dr. William T. Harris, United States commissioner of education, has called an "unrivalled list of excellent works." This new volume, entitled "Thackeray's Lighter Hours," contains "Dr. Birch and his Young Friends," "Selections from the Book of Snobs and the Roundabout Papers," and "The Curate's Walk." Modern Classics has a very extensive sale as a school library, for which it is well suited, as it contains many of the best complete stories, essays, sketches, and poems in modern literature, including selections from the celebrated authors of England and America, and translations of masterpieces by continental writers.

—William M. Goldthwaite, New York, has published a "Driving Road Chart of the Country surrounding New York City." This chart covers every place within twenty miles radius of the City Hall, and in parts extends out to nearly forty. This map will be specially useful to all living in or near the city, or contemplating removing to it.

—Herbert Ward, in the preface to his "Five Years with the Congo Cannibals," tells his story of the rear-guard of the Stanley expedition for the relief of Emin Pacha. The trials of those left behind by Mr. Stanley when he pushed forward, the fate of Major Barttelot and Mr. Jameson, and Mr. Ward's own part in the transactions of that trying period, form an interesting chapter in the history of Mr. Stanley's great enterprise.

—A map of the valley of Virginia, showing the location of all the industrial towns, battle-fields, mountain-passes, and Luray caverns (10 cents), is published by Alex Y. Lee, C.E., Luray, Va.

—Volume II. of the "Bulletin of the Illinois State Laboratory of Natural History, Champaign, Ill.," contains the following articles: "Descriptive Catalogue of the North American Hepaticæ, North of Mexico," by Lucien M. Underwood; "Description of New Illinois Fishes," by S. A. Forbes; "Parasitic Fungi of Illinois," Part I., by T. J. Burrill; "Studies on the Contagious Diseases of Insects," I., by S. A. Forbes; "List of the Described Species of Fresh Water Crustacea from America, North of Mexico," by Lucien M. Underwood; "Parasitic Fungi of Illinois," Part II., by T. J. Burrill and F. S. Earle; "Studies of the Food of Fresh-Water Fishes," by S. A. Forbes; and "On the Food Relations of Fresh-Water Fishes," by S. A. Forbes. Vol. III. of the same publication contains, among others, the following articles: "A Descriptive Catalogue of the Phalangiinæ of Illinois," by Clarence M. Weed; "A Partial Bibliography of the Phalangiinæ of North America," by Clarence M. Weed; "On an American Earthworm of the Family Phreoryctidæ," by S. A. Forbes; "An American Terrestrial Leech," by S. A. Forbes; "A Preliminary Report on the Animals of the Mississippi Bottoms near Quincy, Ill., in August, 1888," Part I., by H. Garman; and "Notes on Illinois Reptiles and Amphibians,

Publications received at Editor's Office, Oct. 20–Nov. 8.

Abbott, C. C. Outings at Odd Times. New York, Appleton. 282 p. 16°. $1.50.

Ball, W. P. Are the Effects of Use and Disuse inherited? (Nature Series.) London and New York, Macmillan. 156 p. 12°. $1.

Belding, L. Land Birds of the Pacific District. (Occasional Papers of the California Academy of Sciences, II.) San Francisco, Cal. Acad. Sci. 274 p. 8°. $2.50.

Cope, R. The Distribution of Wealth: or, The Economic Laws by which Wages and Profits are determined. Philadelphia, Lippincott. 364 p. 8°. $2.

Durham, W. Astronomy. Sun, Moon, Stars, etc. (Science in Plain Language.) Edinburgh, Black. 133 p. 12°. (New York, Macmillan, 50 cents.)

Eigenmann, C. H. and Rosa S. A Revision of the South American Nematognathi or Cat-Fishes. (Occasional Papers of the California Academy of Sciences, I.) San Francisco, Cal. Acad. Sci. 508 p. 8°. $3.

Elderton, W. A. Maps and Map Drawing. London and New York, Macmillan. 129 p. 24°. 35 cents.

Electric Railway Advertiser. Vol. I. No. 2. f. Boston, Mass., G. L Austin. 44 p. f°. $1 per year.

Game Laws, Book of the. Vol I. No. 1. New York, Forest and Stream Publ. Co. 228 p. 8°. 50 cents.

Latimer, L. H. Incandescent Electric Lighting. A Practical Description of the Edison System. (Van Nostrand's Science Series, No. 57.) New York, Van Nostrand. 140 p. 18°. 50 cents.

Lindsay, T. B., ed. The Satires of Juvenal. New York, Cincinnati, and Chicago, American Book Co. 226 p. 16°.

McLennan, E. Cosmical Evolution: A New Theory of the Mechanism of Nature. Chicago, Donohue, Henneberry, & Co. 399 p. 12°.

Musick, T. H. The Genesis of Nature considered in the Light of Mr. Spencer's Philosophy, as based upon the Persistence of Energy. New York, J. B. Alden. 377 p. 12°.

Rosa, D. Le Nov Latin International Scientific Lingua Super Natural Bases. (Bollettino dei Musei di Zoologia ed Anatomia comparata della R. Università di Torino, vol. v. No. 89.) Torino, Libreria Carlo Clausen. 10 p. 8°.

Shepherd, H. A. The Antiquities of the State of Ohio. Cincinnati, Robert Clarke & Co. 139 p. 4°. $2.

Shufeldt, R. W. The Myology of the Raven (Corvus corax sinuatus). London and New York, Macmillan. 343 p. 8°. $4.

Teachers' Manual. Public Schools of the District of Columbia. Washington, Linotype Print. 84 p. 8°.

Thoreau's Thoughts: Selections from the Writings of Henry David Thoreau. Ed. by H. G. O. Blake. Boston and New York, Houghton, Mifflin, & Co. 153 p. 16°. $1.

Tuckerman, A. Index to the Literature of Thermodynamics. Washington, Smithsonian Inst. 239 p. 8°.

Velschow, F. A. The Natural Law of Relation between Rainfall and Vegetable Life, and its Application to Australia. London, Edward Stanford. 40 p. 8°. 25 cents.

Wallace, W. Life of Arthur Schopenhauer. London, Walter Scott; New York, A. Lovell & Co. 217 p. 12°. 40 cents.

Woodhull, A. A. Notes on Military Hygiene, for Officers of the Line: A Syllabus of Lectures at the U. S. Infantry and Cavalry School. New York, Wiley. 150 p. 16°.

including Several Species not before recorded from the Northern States," by H. Garman.

—The annual of the Office of Naval Intelligence (United States Navy Department), bearing date of June, 1890, has just appeared. It is No. IX. of the General Information Series, and is intended to biing to the attention of naval officers and others interested in naval matters the year's progress in naval development abroad, and to preserve a record of it in permanent form for reference. The volume exhibits the progress of foreign nations rather than that of our own; and the information conveyed in the "Notes," which occupy the most prominent place in the volume, is compiled from professional papers and journals, almost all of it having already appeared in print. Among the contents are notes on ships and torpedo-boats and on machinery, ordnance, and armor; on the application of electricity in the navy; and on the naval manœuvres of 1889. There are also papers on "The Ministries of Marine and Personnel of Several European Navies," "Administration of the Merchant Marine in Foreign Countries," "The Development of Rapid-Fire Guns for Naval Use," "The Year's Development of Home Resources for the Production of War Material," "Liquid Fuel for Torpedo-Boats," "The Manœuvring Distances of Steamers," and "Automobile Torpedoes." Twelve plates add to the value of the work.

—*The Popular Science Monthly* will make a new departure in 1891 by publishing a series of comprehensive and fully illustrated articles on "The Development of American Industries since Columbus," in which the progress of iron and steel making, of the cotton manufacture, and of the woollen, glass, leather, and other leading industries, will be described by writers of long practical acquaintance with their respective subjects. It has been announced that one of the features of the coming world's fair is to be a comparison of the great manufactures of to-day with the condition of the same industries at the discovery of America, and it is the design of these papers to describe the successive steps by which the distance between those two stages has been passed over. The series begins in the issue for December, 1890 (the second number of Volume XXXVIII.), with an account of the first steps in iron-making in the Colonies, written by Mr. W. F. Durfee of Pennsylvania. The full prospectus of the *Monthly* for the coming year will be printed in the same number. Hon. David A. Wells will also begin during the coming year a series of papers on "The Principles of Taxation;" Dr. Andrew D. White's "New Chapters in the Warfare of Science" will be continued; and other articles bearing upon the advances of science, and upon questions of the day, are promised. What shall we do with the "Dago"?—a puzzling question that seems likely to take rank with the Chinese problem—will be discussed by Mr. Appleton Morgan in the December number. Among the greatest achievements of science are the discoveries that sound, heat, and light are vibratory movements, each in its proper medium. The nature of electricity, however, has long remained unknown; but at last Dr. Henri Hertz of Heidelberg has reached a result that has been widely accepted by the most eminent physicists. A translation of his own account of his discoveries, under the title "The Identity of Light and Electricity," will be printed in the same number. The bore of the Amazon will also be described by Mr. John C. Branner, State geologist of Arkansas. The "bore," which is one of the most impressive phenomena of nature, occurs only in narrow estuaries where high tides prevail.

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Nov. 8.—J. Elfreth Watkins, The Beginnings of Engineering; J. Howard Gore, The Decimal System of the Seventeenth Century.

Academy of Science and Art, Pittsburgh, Penn.

Nov. 7. — Gustave Guttenberg, Some Thoughts suggested by a Visit to the Allegheny Conservatory (illustrated by lantern slides).

Appalachian Mountain Club, Boston.

Nov. 12.—William H. Niles, Influence of Mountains upon Human Life.

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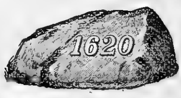

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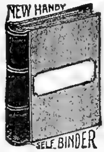

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THE PROBLEMS OF COMPARATIVE OSTEOLOGY.[1]

OSTEOLOGY is the study of the bones or the skeleton of vertebrates. Comparative osteology is the study of the origin and evolution of the different modifications of the skeleton. It could also be called "morphology of the skeleton" It not only regards the living forms alone, but considers the fossil forms exactly in the same way. As we know nothing but the skeleton of the extinct vertebrates, comparative osteology becomes the real basis of vertebrate phylogeny. All our systems of vertebrates have to be founded on characters derived from the skeleton. It is quite evident, therefore, that comparative osteology is one of the most important branches of vertebrate morphology. It alone enables us to give an exact and scientific explanation of the origin and evolution of vertebrates, and so it is the real foundation of the morphology of these animals.

Comparative osteology may be divided into three branches: 1. Osteology of the living forms; 2. Osteology of the extinct forms; 3. Evolution of the skeleton.

It is the task of the first-named branch—osteology of the living forms—to study the skeleton of the living forms in as complete a manner as possible. A characteristic genus of each family ought to be examined, and the characters of the families given on this basis. It especially regards such groups of animals as are very isolated to-day, and of the origin of which we know very little or nothing through paleontology. Such animals are, for instance, the *Monotremata*, the ostriches, chameleon, *Necturus*, *Hippocampus*. At the same time it aims to study with great care such forms as in former periods must have been abundant, and which are represented to day, perhaps, by a single genus only. Such forms are *Hyrax*, *Apteryx*, *Sphenodon*, *Polypterus*, *Ceratodus*, and many others.

There are different ways to work in this branch. One man may give a most complete osteology of a single form, for instance, the chicken; but this purely descriptive work will be of little scientific value in itself, though it will become valuable for him who gets the philosophy out of it, and who traces the relations and origin of the form described. Notwithstanding, such work is very often important, if forms which are very rare or difficult to get are treated in this way. A pure description, for instance, of the osteology of the peculiar tortoise *Carettochelys* from New Guinea, would be very important, because it would enable us to give the correct systematic position to this form. Of the greatest importance is the study of osteological variations in a genus or a species. Darwin's publications in this direction are known to everybody, and Nehring in Germany has devoted much time to it. Such researches ought to be undertaken oftener, as they are of the greatest value for the explanation of the origin of species. Another man may study all the skulls of the members of a family, or an order, or a class, or even of all living vertebrates, and thus give a complete history of the osteology of the skull; or he may treat the vertebræ, the shoulder-girdle, the pelvis, the limbs, in the same way. Such researches are extremely important; but, by considering one part of the skeleton alone, it may happen that parallel forms may be considered as nearly related which in fact have nothing whatever to do with each other.

[1] Abstract of a lecture given by Dr. G. Baur at Clark University, Worcester, Mass., Oct. 17, 1890.

It is by this method of study that the great homologies of the skeleton have been worked out Of course, the time of the archetype idea of the skeleton belongs now to the past, or nearly so; but it has been followed by a time which has gone a step too far with its tendency to homologize every thing. In this, great care is necessary. There are elements and formations which have no homologues. I recall the interparietal of mammals. This bone appeared in the mammalian line, doubtless produced by the increase of the brain. It is a new formation in the special branch of mammals which has no homologue among lower vertebrates. When the predentary bone was found in iguanodon, a homologue was eagerly searched for; but this bone is a new formation in the peculiar group of *Orthopoda* to which iguanodon belongs, and has no homologue among lower forms. I could multiply these examples (the tympanic of mammals belongs here, for instance), but I will mention only one other case. There is much said at present about hexa- or hepta-dactylism of the mammalian hand, homologues for the additional digits are looked for among fishes, and we hear about the polydactyl ancestors of mammals; but it is forgotten that mammals came from pentadactyl reptiles, and reptiles from pentadactyl batrachians, and that these rudimentary additional digits in mammals are simply of recent independent origin, and have no homologues. The same is true of the polydactyl forms of ichthyosaurs, of the hexadactyl hind-limb of frogs, and of all higher vertebrates with polyphalangeal digits, as the *Plesiosauria*, *Mosasauridæ*, *Sirenia*, *Cetacea*. It is by studying only one part of the skeleton, without consideration of the others, that such mistakes in homology are made. So it is that the fins of ichthyosaurs were considered for a long time, and by some still to-day, as forming the missing link between fishes and reptiles

A third man may study the osteology of a group of vertebrates as a whole; for instance, the ungulates, or the parrots, or the crocodiles, or salmons. He will compare all the skulls, the limbs, the vertebræ and so on, of such a group, trying to trace the origin and relation of its members. He will have a big task, but he will get nearest to the truth. But even if he should study the skulls of all living species of vertebrates, or the complete osteology of all living forms, his general results on origin and affinity of the different groups would be very incomplete.

Here paleontology comes in with a helping hand. I mean true morphological vertebrate paleontology, not that old "geological" paleontology. Paleontology of vertebrates, when studied without anatomical knowledge, is of no use: in this case it is generally nothing more than a lumber-room of names of so-called new species or genera, mostly based on insignificant fragments or specimens insufficiently described. That old paleontology should be abolished entirely. A geologist ought to remain in his own domain, geology, and leave paleontology alone, if he is not, what is seldom the case, a thorough anatomist. This is true also of invertebrate paleontology. The splendid publications of Hyatt, Jackson, Beecher, and Clarke, for instance, are written from this standpoint. Vertebrate paleontology is nothing but a branch of comparative osteology, which in itself belongs to vertebrate morphology. It is very remarkable that the museums of natural history are not arranged according to this natural system. Here we find with one exception (the Museum of the Royal College of Surgeons of London) the bones of extinct animals

separated from those of the living ones; not only separated in different rooms or parts of the building, but separated in different departments. The bones of the living animals we generally find with the skins or near them. The bones of the fossil forms we find either in a special department or in the geological department. It is absolutely necessary to exhibit the bones of fossil and living animals together in one section.

The morphologist will not waste his time and that of others in giving new names to every miserable fragment of a skull, or a vertebra, or a limb-bone: he will study the fossil forms exactly as the living ones, with the greatest detail. He will take the utmost care to work the bones out of the rock, not leave them to show people how nicely they were embedded in the matrix. How can a man study the bones of living forms if he does not remove the muscles? By treating the fossil bones exactly as the living ones, it is possible to make a direct comparison with the greatest minuteness; and thus alone can we get satisfactory results. How many important extinct forms exist, of the osteology of which we know but little, simply because they have not been worked out sufficiently! I may mention, that, of the triassic *Aetosauria*, a group of two dozen specimens is preserved in a splendid condition; but about this very remarkable order of reptiles we know very little, simply because it has not been worked sufficiently out of the rock.

I stated above, that a man, if he should study all forms of living animals, would get no clear results without paleontology; but very often we find living forms for which we receive no help even through paleontology, the ancestors of which are not yet found. In this case the third branch of osteology comes in,—embryology, or evolution of the skeleton. Of course, in very rare cases only, we can study the evolution of the skeleton of an extinct form; such a rare case is offered, for instance, by the Permian batrachian *Branchiosaurus*, of which Professor Credner has given the development. The evolution of the skeleton of living forms is of the greatest importance for comparative osteology, and I will demonstrate it by a few examples.

We know little about the ancestors of the *Bovidœ;* but by studying the evolution of their limbs we find that the earliest embryos show four well-developed metapodials, distinct from each other. Gradually the side metapodials become reduced, and the median ones unite. We can safely say that the ancestors of the *Bovidœ* had at a former period four distinct metapodials, which became modified from time to time until the conditions were reached which we see to-day. Another very instructive example is offered by the *Carnivora*, dogs, cats, and so on. In the carpus of the living animals we find that the radial, intermedial, and central are represented by a single bone, but in the embryo we find three distinct cartilages which unite later to form this one bone. This we knew long ago, before we had any idea of these parts in the ancestors of the *Carnivora;* and we could say with confidence that these ancestors must have three distinct bones in the carpus, in the place of one. The limb-bones of some of the *Creodonta*, the ancestors of the *Carnivora*, were discovered subsequently, and showed the three bones.

We know the whole paleontological history of the horse, down to the pentadactyl *Phenacodus* from the lower eocene, but we hardly know any thing about the embryological history of this animal. This, when known, will show the gradual evolution of the peculiar monodactyl foot. Of course, it will not represent the early *Phenacodus* in the earliest embryo (too many generations have gone since the lower eocene, and the embryological history is obscured), but it will doubtless show three well and more equally developed metapodials, and possibly the representative of a fourth one. Here a man could do great service to science by collecting the necessary material in one of the places where the horse has become wild.

But the embryologist has to be sceptical with his conclusions also in osteology. He must never forget that the embryological history is very much abbreviated, and that only the later stages will be indicated in the skeleton of the embryo. But this study is very rewarding, and, in connection with osteology of living and fossil forms, gives splendid views of the origin and evolution of vertebrates. This branch of osteology, I am sorry to say, has not been treated with the interest it deserves. Embryologists generally stop after they have found out about the formation of the germ-layers. Very seldom an animal is studied up to its adult stage. It is true, the late Professor W. K. Parker has published numerous works on the evolution of the skull of different vertebrates, and these we find cited very often as examples of such a kind of study; but these researches suffer very much from the lack of paleontological knowledge, a number of the statements brought forward are unreliable, and the general conclusions are usually too vague. In these numerous papers we miss the true phylogenetic sense, which alone can lead to true results. Had he, with his great diligence, considered more the results of paleontology and taxonomy, he would have done very much more for the phylogeny of vertebrates.

I can only repeat here, what I said eight years ago in my paper on the "Tarsus of Birds and Dinosaurs:" "Palaeontologie und Entwicklungsgeschichte des Skeletsystems müssen Hand in Hand gehen. Wenn wir palaeontologische Reste studiren wollen, so müssen wir die Skeletogenese des Thieres, welches ihm am nächsten verwandt ist, zuvor kennen. Ich halte daher die Genese des Skeletsystems der Wirbelthiere von eben so hoher Bedeutung, wie die ersten Vorgänge am Ei und die Entstehung der Keimblätter."

Osteology of living forms, osteology of fossil forms, evolution of the skeleton, must go hand in hand. No one of these branches is sufficient in itself: it becomes complete only by the assistance of the two others. So osteology of living forms is deficient without paleontology and embryology of the skeleton; so paleontology is deficient without osteology and embryology of the living forms; so embryology is deficient without osteology of living and fossil forms. All three equally and harmoniously united are able to explain and to unriddle that complicated genealogical tree of vertebrates, with its numerous branches and branchlets, and to conceive the origin of man.

REPORT OF THE MARINE BIOLOGICAL LABORATORY AT WOOD'S HOLL.

The trustees have the pleasure of reporting to the corporation another year of prosperity to the laboratory.

During the last summer those working in the laboratory numbered no less than forty-five, and the tuition-fees amounted to \$959, as against \$845 during 1889, and \$363 during 1888.

During the last summer the laboratory offered greater advantages for study and collecting than ever before, and it may be confidently expected that in the future the receipts from tuition-fees will be even larger. The trustees learn with pleasure that the gentlemen in charge of the department of instruction report that the quality of the elementary students and the work done by them is decidedly better than in previous years.

The two Lucretia Crocker scholarships, of fifty dollars each, were held by Miss A. F. Armes and Miss Nellie L Shaw, both teachers in the Boston public schools.

During the summer of 1889 the need of a lecture-room was keenly felt. Every available place in the laboratory being occupied by a work-table, it was impossible for students to gather around the lecturer without completely disarranging the laboratory. Experience had also shown that some more advanced students did not need to attend every lecture given, but could spend the time allotted to certain lectures to greater advantage if allowed to continue their laboratory work. This could not be done conveniently while lectures were in progress. Further, in accordance with the plan adopted by the director, evening lectures of a more advanced character were given from time to time. These were attended by both students and investigators, an aggregate of over forty persons. The interest in and instructiveness of these lectures were much marred by the discomforts of the surroundings. The library had also outgrown the quarters to which it was originally assigned, and during the summer of 1889 the number of rooms for investigators was less than the number of applicants.

In view of remedying these defects, the trustees have added an L to the present building. This addition contains a comfortable and convenient lecture-room, a pleasant library, and six investi-

gators' rooms, which, like those in the main building, are fitted with aquaria and supplied with running sea-water. All workers at the laboratory during last summer fully appreciate the advantages gained by this addition.

The library has been considerably enlarged by gifts from numerous friends. Although we were unable to purchase any books, the current subscriptions to journals have been maintained. The following list gives the donations received as far as catalogued: G. Baur, 12 pamphlets; J. N. Coulter, 2 volumes and 2 pamphlets; Stanley Coulter, 2 pamphlets; W. G. Farlow, 2 volumes and 3 pamphlets; C. P. Barnes, J. W. Fewkes, W. F. Ganong, J. S. Kingsley, each 1 pamphlet; Dice McLaren and W. S. Miller, each 1 volume and 1 pamphlet; T. Wesley Mills, 16 pamphlets; C. S. Minot, 15 volumes and 6 pamphlets; Francis Minot, 20 volumes; H. F. Osborn, 7 volumes and 8 pamphlets; A. S. Packard, 9 volumes and 116 pamphlets; Peabody Academy of Sciences, Salem, 5 volumes; Samuel H. Scudder, 1 volume,—a total of 62 volumes and 171 pamphlets. Other gifts were received from A. Agassiz, California Academy of Science, R. Ellsworth Call, C. and R. S. Eigenmann, E. G. Gardiner, Mrs. Gifford, J. E. Ivers, T. H. Morgan, E. S. Morse, W. A. Satchell; but, as these have not returned from Wood's Holl, they have not been catalogued. The most important gift was from Dr. Francis Minot, and included Agassiz's "Contributions" and a series of the publications of the American Academy. The additions go far towards completing our sets of the *American Naturalist* and of the *Botanical Gazette*.

During the former seasons both students and investigators have felt the need of better collecting facilities than the laboratory could offer. Although well supplied with row-boats, the strong tides which prevail in the neighboring waters rendered it imperative for the laboratory to have the use of a steam-launch. Many of the localities where the richest fauna and flora were to be found were beyond the reach of either sail or row boats.

Last spring the trustees supplied this deficiency in the equipment by the purchase of the "Wyandotte," a most excellent launch, designed by Edward Burgess, and in every way suitable to the work. During last summer the "Wyandotte" fully demonstrated her usefulness, dredging and collecting excursions being made every day when the weather was suitable.

Last August the Gifford homestead, which consists of upward of half an acre of land, closely adjoining the lot on which the laboratory stands, and a substantial old house, was advertised at forced sale. The trustees have long believed that in the near future the land and house would be of great value to the laboratory, but have been deterred from purchasing by lack of funds. Appreciating that the amount for which this property could be purchased (thirty-five hundred dollars) was small considering its real value, J. S. Fay, Esq., advanced the money for the purchase, holding a mortgage on the property for three thousand dollars. This generous act secures the property to the laboratory, and at the same time presents the trustees with the sum of five hundred dollars. Since the laboratory was first opened, Mr. Fay has shown by his liberality great interest in its success, and the trustees have once again to thank him most cordially. Their thanks are also due to Professor McDonald, United States commissioner of fisheries, for many courtesies extended by him and his staff to our officers and students.

We are again, as in past years, under obligations to Miss Fay for the use of Gardiner cottage for a mess-room for those working in the laboratory. This last summer the mess was under the immediate charge of one of the officers of the laboratory, and if not in every way satisfactory, yet was on the whole as good as circumstances would allow.

It is hoped that the experience gained will be of service in whatever arrangement may be made another year. The laboratory now owns a complete mess outfit, including tables, chairs, stove, cooking utensils, and table furniture; and it is believed that the house of the newly acquired property can be adapted to a permanent mess-room at small expense.

The trustees believe that the laboratory is now fully equipped; and, until an effort is made to establish a permanent laboratory, but little outlay on improvements will be necessary.

They would, however, again remind the corporation that the success of the laboratory is largely due to the voluntary efforts of the director and his corps of assistants. They have worked faithfully and without further remuneration than their personal expenses while at Wood's Holl. In many cases the work was very arduous, allowing little or no time for study or investigation. It is to be hoped that at least those who give their whole time to the laboratory will in the future receive some compensation.

As the success of the laboratory has greatly exceeded expectation, and warrants the largest hopes for the future, your trustees consider it imperative that an effort be made at once to place the laboratory upon a permanent footing; and they have accordingly voted to take immediate steps to raise sixty thousand dollars, which, when the indebtedness incurred the past season is removed, will yield an annual income sufficient not only to carry it on as heretofore, but to pay a small stipend to those on whose voluntary assistance in direction and instruction we have been dependent for success. The trustees invite your earnest co-operation in securing this amount. The proved usefulness of the laboratory, the great demand for the privileges it offers, and its present far-reaching influence, demonstrate the need for a permanent establishment, and enable us to make our appeal to the public with pride in our brief past, and confidence in our future.

AID TO ASTRONOMICAL RESEARCH.

PROFESSOR EDWARD C. PICKERING of Harvard College Observatory has issued a circular (No. II.) on the above subject. A circular was issued last summer, announcing the gift by Miss Bruce of six thousand dollars for aiding astronomical research. No restrictions were made upon its expenditure which seemed likely to limit its usefulness, and astronomers of all countries were invited to make application for portions of it, and suggestions as to the best method of using it.

Eighty-four replies have been received, says Professor Pickering, and with the advice of the donor the entire sum has been divided so as to aid the following undertakings: Professor W. W. Payne, director of the Carleton College Observatory, for illustrations of the *Sidereal Messenger;* Professor Simon Newcomb, superintendent of the American "Nautical Almanac," for discussion of contact observations of Venus during its transits in 1874 and 1882; Dr. J. Plassmann, Warendorf, for printing observations of meteors and variable stars; Professor H. Bruns, treasurer of the *Astronomische Gesellschaft,* to the *Astronomische Gesellschaft* for the preparation of tables according to Gyldén's method for computing the elements of the asteroids; Professor J. J. Astrand, director of the Observatory, Bergen, Norway, for tables for solving Kepler's problem; Professor J. C. Adams, director of the Cambridge Observatory, England, for a spectroscope for the 27-inch telescope of the Cambridge Observatory; Professor A. Hirsch, secretary of the International Geodetic Association, to send an expedition to the Sandwich Islands to study the annual variation, if any, in latitude; H. H. Turner, Esq., assistant in Greenwich Observatory, for preparing tables for computing star corrections; Professor Edward S. Holden, director of the Lick Observatory, for reduction of meridian observations of Struve stars; Professor Lewis Swift, director of the Warner Observatory, for photographic apparatus for 15-inch telescope; Professor Norman Pogson, director of Madras Observatory, for publication of old observations of variable stars, planets, and asteroids; Dr. Ludwig Struve, astronomer at Dorpat Observatory, for reduction of observations of occultations during the lunar eclipse of Jan. 28, 1888, collected by the Pulkowa Observatory; Dr. David Gill, director of the Observatory of the Cape of Good Hope, (1) for reduction of heliometer observations of asteroids, (2) for apparatus for engraving star-charts of the "Southern Durchmusterung;" Professor A. Safarik, Prague, for a photometer for measuring variable stars; Professor Henry A. Rowland, Johns Hopkins University, for identification of metals in the solar spectrum.

Of the remaining replies, many describe wants no less urgent than those named above. Some relate to meteorology or physics rather than to astronomy, some to work already completed, and others were received too late to be included. Two important

cases may be specially mentioned. In each of them an appropriation of a part of the sum required would have been made; but in one (in our own country) an active and honored friend of the science undertakes the whole, and in the other (in France) the generous M. Bischoffsheim, already known as the founder of the great observatory at Nice, ignoring political boundaries and the comparative selfishness of patriotism, came forward and gave the entire sum required. It is to be hoped that the above named, and other foreign institutions, will obtain more important aid from neighbors when these become aware how highly the work of their scientists is appreciated in this country. The replies not enumerated above are confidential, and cannot be mentioned except by the permission of the writers; but they have placed Professor Pickering in possession of important information regarding the present needs of astronomers. In several cases a skilful astronomer is attached to a college which has no money for astronomical investigation. He has planned for years a research in the hope that some day he may be able to carry it out. A few hundred dollars would enable him to do this, and he offers to give his own time, taken from his hours of rest, if only he can carry out his cherished plans.

Such valuable results could be attained by the expenditure of a few thousand dollars, that no opportunity should be missed to secure this end. Fortunately, the number of persons in the United States able and willing to give liberally to aid astronomy is very large. It is hoped that some of them may be inclined to consider the case here presented. The income derived from a gift of one hundred thousand dollars would provide every year for several cases like those named above. A few thousand dollars would provide immediately for the most important of the cases now requiring aid. The results of such a gift would be very far-reaching, and would be attained without delay. Correspondence is invited with those wishing to aid any department of astronomy, either in large or small sums, by direct gift or by bequest.

HEALTH MATTERS.

Small-Pox Extinct in Ireland.

NOT a single death from small-pox was registered in Ireland last year, says the *Medical Record*. From this scourge, at all events, "the distressful country" appears to be gradually freeing itself. Over the last ten years the average annual number of deaths was a hundred and thirty, but this average is due to the more serious state of things prevailing in the early stages of the decade. Since 1883 there has only been one year in which the number of deaths from small-pox was as high as fourteen. That was in 1887. In 1885 there were but four deaths from small pox registered in Ireland; in 1886, two; in 1884 there was only one; in 1888 there were three; and, as above stated, in 1889 there was not one.

BOOK-REVIEWS.

Dragon-Flies versus Mosquitoes. Studies in the Life-History of Irritating Insects, their Natural Enemies, and Artificial Checks by Working Entomologists. With an introduction by ROBERT H. LAMBORN, Ph.D. New York, Appleton. 12°.

THIS neat little volume contains the three prize essays elicited by Dr. Lamborn's circular of July 15, 1889, addressed to the working entomologists of the country. The first prize ($150), as Dr. Lamborn informs us in his introduction, was awarded to Mrs. C. B. Aaron of Philadelphia; the second and third prizes, amounting to $30 and $20 respectively, were divided equally between Mr. A. C. Weeks and Mr. W. Beutenmüller, both of New York. The essays were to treat of the best methods of destroying mosquitoes and house-flies with special regard to the agency of dragon-flies.

Taking into consideration the fact that the essays were to be forwarded at the expiration of eighteen weeks from the time the circular was distributed, the three contributions must certainly be regarded as most creditable to their authors. We believe that Dr. Lamborn, at the time of distributing his circular, could have had no conception of the time required to accomplish any thing of practical or theoretical importance on a difficult entomological question. Large portions of the essays are, as was to be expected, devoted to old and well-established facts in regard to the life-histories, metamorphoses, and morphology of the mosquito, fly, and dragon-fly. These descriptions will be read with interest by all lay readers, whose ignorance of the wonderful life-histories of our most common insects is as glaring as it is inexcusable. But, besides these trite facts, Mrs. Aaron and Mr. Beutenmüller have contributed some points of interest to the specialist. Such are, for instance, Mrs. Aaron's account of her experiments in killing mosquito larvæ and pupæ with petroleum, and Mr. Beutenmüller's carefully prepared preliminary catalogue of the described transformations of the *Odonata* of the world.

Dr. Lamborn's idea of artificially rearing dragon-flies for the purpose of exterminating flies and mosquitoes seems to have met with little favor from the three contributing entomologists. Mr. Weeks concludes that "any attempt to destroy flies and mosquitoes by the artificial propagation of dragon-flies or any other insect would be impossible, unadvisable, and impracticable." Various methods of destruction other than odonat culture are proposed by Mrs. Aaron and Mr. Beutenmüller, such as sprayed petroleum (for the larvæ and pupæ), flushing and grading of land, cultivation of fungoids, the employment of attracting-lamps in the neighborhood of marshes, the rearing of fish and the encouragement of water-fowl where fresh water is abundant. It is to be regretted that the circular did not elicit some work on the distribution and systematic study of our North American *Culicidæ*, a branch of dipterology in which no work of any real value has been done; but this could hardly have been expected from the brief time allotted for competition.

The three essays are followed by a letter on dragon-flies as mosquito hawks on the Western Plains, by Mr. C. N. B. Macauley, and a brief article on the extermination of mosquitoes (reprinted from the *North American Review*, September, 1889), by the well-known arachnologist, Professor H. C. McCook. The work is provided with nine plates, one of which is colored, a useful index, and an extended bibliography to Mrs. Aaron's essay.

Manual Training in Education. By C. M. WOODWARD. (Contemporary Science Series.) New York, Scribner. 12°. $1.25.

THIS book contains an exposition of what manual training is, and also an elaborate and somewhat vehement defence of it. The author is director of the manual-training school of Washington University at St. Louis; and the scheme of manual exercises presented in this book is derived in the main from his own practice. Mr. Woodward, however, is by no means disposed to confine manual training to such special schools, but wants to make it compulsory on all the school-children in the country. His arguments are those with which our readers are already familiar. He advocates manual exercises partly as a means of promoting industrial efficiency and thereby helping the rising generation to earn their daily bread, and partly as a means of intellectual culture. The former argument is much the more effective, and the addition of the latter is by no means an advantage. The plea for manual training on the ground that it promotes intellectual culture is very flimsy, and the sooner it is abandoned the better. The present writer has had more than twenty years of manual training and practice in various branches of work from farming to organ-playing, but not a particle of intellectual benefit has he derived from it. As for the culture of the perceptive faculties, about which so much has been said, that is best obtained by the observation of human nature and human life, which are to most persons the chief objects of interest; and this observation goes on spontaneously without the help of teacher or school. What may be the merits of manual training as a preparation for regular industry, and how far its adoption in the public schools is justifiable on that ground, are questions into which we shall not enter here. That special technical schools like that presided over by Mr. Woodward are useful, there can be no doubt; but the success of such schools composed of picked pupils proves nothing as to the expediency of compulsory manual training for all pupils. Meanwhile those who wish to know what manual training is, and what can be said in its favor, will find this book a help.

The Myology of the Raven (Corvus corax sinuatus). A Guide to the Study of the Muscular System in Birds. By R. W. SHUFELDT. London and New York, Macmillan. 8°. $4.

THIS is a very unsatisfactory work, but fortunately of a unique character. According to its contents, it may be divided into three parts. The first consists of a badly arranged and insufficient description of the muscles of the raven, which constitutes the author's own work. In this, not the slightest notice is taken of the valuable papers and monographs of Professors Fuerbringer and Gadow, which form the basis for the morphology of the muscles of birds. The author writes, therefore, from an absolutely antiquated standpoint. The second part is composed of about 70 pages in German, copied from Gadow's recent work on the muscles of birds; and the third, of a bibliography of 144 works. The author prefaces this latter with the words "Important Works and Papers treating of the Muscles of Birds, compiled, abridged, and re-arranged from the Bibliographical Lists of Hans Gadow, and Several Other Sources, as well as Many New Titles added thereto by the Present Writer."

Of these 144 titles, 134 have been copied from Gadow in every detail. A paper of Duvernoy, for instance, is mentioned by Gadow, with the words "Kuerzere Notizen" ("shorter notes"), without giving the long French title. In the author's list this paper appears also under the title "Kuerzere Notizen." The abbreviation of Gadow's list consists in the omission of the very valuable short notes attached to the titles, giving the contents of the paper. It seems to have been too much trouble for the author to translate these notes, which are of such great importance to the student.

Of the ten new titles which are given by the author, four are those of papers which have appeared since Gadow's list was published, three are the titles of little text-books, two have nothing to do with the subject, and one special paper only was published before the appearance of Gadow's list.

In the preface the author says, "To those of my readers who are familiar with German, the best works I can recommend to be consulted in the present connection are the very excellent treatises of Selenka and Gadow in Bronn's 'Klassen des Thierreichs,' and that superb monument to avian morphology, the 'Untersuchungen zur Morphologie und Systematik der Voegel,' of Max Fuerbringer."

We wish the author had studied these works himself before he gave his book into the printer's hands. Perhaps he would have given us something better. But then, we ask, why did the author use and mention, besides his own papers, but 7 of the 144 works of which he gives the titles, in his descriptions? Four of these works are the text-books of Owen, Huxley, Mivart, and Parker: the others are the collected papers of Garrod and Forbes. Milne-Edwards is noted once. From Owen's "Anatomy" the description of the muscles of *Apteryx* is copied, and from the others many a page. The works of such authors as Klemm and Meursinge, who have written specially on the muscles of the raven, are not even mentioned. The explanation is easily given: the author did not take the trouble to read and study the papers the titles of which he gives in the bibliography.

The Distribution of Wealth. By RUFUS COPE. Philadelphia, Lippincott. 12°. $2.

THIS book is another of those ambitious attempts to remedy all the economic ills of society which issue from the press at frequent intervals; and it is about as successful as the rest. The author begins in the usual way by informing us that the distribution of wealth in our day is very unequal, and that sundry evils of more or less portentous import result from this inequality. The facts in the case are set forth with a long array of statistics showing how great the inequality is; and the conclusion is then drawn that this inequality is unjust, and must be remedied. The principal remedies proposed are the abolition or sweeping reduction of interest, the repeal of patent laws, and some not very well defined control of natural and artificial monopolies. To patent laws Mr. Cope has a special antipathy, declaring that "no other single agency, perhaps, except interest on money, is more responsible for the present inequitable distribution of wealth." "Ricardo's law of rent," he says, "appears to be a formula devised as a justification of the rapacity of landlords," yet he is not a disciple of Mr. George. The internal revenue taxes on malt liquors and tobacco he declares to be a great injury to the workingmen; but he is very much in love with the protective tariff, and devotes a large space to a defence of it,—a defence very much needed in view of the recent elections. Such are some of Mr. Cope's ideas, but their merits as a solution of the problem in question are not apparent to us.

Sociology: Popular Lectures and Discussions before the Brooklyn Ethical Association. By various authors. Boston, James H. West. 12°. $2.

THE papers in this volume, though containing many points of interest, are not equal in merit to those that came from the same source a year ago. The editor says in his preface that sociology is the name of a new science,—the science of social evolution. Now, whether such a science, as something distinct from history, is possible or not, we shall not here inquire; but it certainly cannot be found in the pages of this book. The various essays it contains are often interesting and sometimes instructive; but they present nothing that can be called a science of social development. Several of them have no relation to social affairs, the remainder being divided between historical topics and methods of social reform. Some of the historical papers are very good; but they are far from presenting a comprehensive view of social evolution, some of the main elements of which are wholly neglected. We read here about the evolution of law and politics, of the mechanic arts, the science of medicine, and some other branches of human activity; but there is nothing about the general intellectual progress of the race, nothing about the evolution of religion and morals or of ideal art, and, strangest of all, nothing about the evolution of language, the instrument that makes society possible. The lectures on social reform present successively the theological method, the socialistic method, the anarchistic method, and the scientific method. That on the socialistic method, by a man who was at first attracted by the socialistic dream, but in the end strongly repelled by it, has been to us the most interesting. The two closing papers are tributes to the memory of Professors Asa Gray and Edward L. Youmans, written with the warmth of friendship as well as of scientific enthusiasm, and describing the services they rendered to science and to education. The discussions that followed the original delivery of the lectures are not reported in this volume, except in two cases; and we regret the omission, as we found those in the former volume on "Evolution" as interesting and suggestive as the lectures themselves.

Life of Arthur Schopenhauer. By W. WALLACE. London, Walter Scott; New York, A. Lovell & Co. 16°. 40 cents.

THIS volume is one of the series of Great Writers, of which many numbers have already been issued. It gives a clear and very readable account of Schopenhauer's life, with some notice of his philosophy. The materials for a biography are indeed few; for a philosopher's life is usually uneventful, and Schopenhauer's is no exception to this rule. There were, however, certain peculiarities in his life and character, which lend a somewhat peculiar interest to his biography, and make it read like a mixture of tragedy and comedy. His pessimism is often ludicrous, especially in a man who, after his eighteenth year, had nothing to do but what he chose to do; yet his natural tendency to melancholy, combined with his inordinate passion for fame, made him not only pessimistic in theory, but often really unhappy, in fact. His philosophy was late in winning recognition, and has never attained to much prominence in the world of thought; and it was this failure to win disciples which, more than any thing else, caused his melancholy. He believed that Hegel and other professional philosophers had conspired against him, and he vents on them all the vials of his wrath. Yet his works have undoubtedly received all the favor to which they are entitled, if not more, the exaggerated estimate which he formed of their originality and importance being wholly unjustified. Meanwhile, students of modern philosophy will be glad of this brief biography of the strange author of a strange metaphysical system. His leading work has for some time been accessible in English, while more recently a translation

of some of his shorter works has appeared; and, now that we have a good sketch of his life, English readers can easily learn all they may wish to know of the great pessimist of Germany.

The Colours of Animals, their Meaning and Use, especially considered in the Case of Insects. By EDWARD BAGNALL POULTON. (International Scientific Series, Vol. LXVII.) New York, Appleton. 12°.

WITH this volume another new and valuable member is added to the classical International Scientific Series. It comes to us with the fascinating qualities which accurate and well-written accounts of animal life must have both for the general reader and the biologist. Mr. Poulton has given his book a general title, though it treats mainly of the origin of colors in insects, and more especially in moths and butterflies. This use of a general title may be excused on the ground that nearly all the difficulties in explaining the evolution of color in the animal world are met with among insects. After devoting an introductory chapter to the structures in animal tissues whereby colors are produced, the author proceeds to discuss the origin of colors by means of natural selection. Animal colors are classified as non-significant and significant; and the latter category is again subdivided into colors of direct physiological value to the organism (chlorophyl, pigment, etc.), colors of protective and aggressive resemblance, colors of protective and agressive mimicry, warning colors, and colors displayed in courtship. Each of these classes of significant colors is then taken up in order, and discussed at length, with numerous illustrations drawn mainly from the group of lepidopterous insects. It is impossible in this brief notice to do full justice to the wealth of interesting examples with which the author presents us. Only a very small portion of the work deals with the hackneyed cases of mimicry and protective resemblance found in zoölogical text-books. Many of the observations are original, and others are taken from the recent works of reliable investigators. Perhaps the most original portion of the volume is that which treats of the author's own experiments on the chrysalides of the butterflies. He exposed larvæ to surfaces of different colors during pupation, with results which may be briefly summarized in his own words:—

"I worked upon the allied small tortoise-shell butterfly (*Vanessa urticæ*), which can be obtained in immense numbers. In the experiments conducted in 1886, over 700 chrysalides of this species were obtained, and their colors recorded. Green surroundings were first employed in the hope that a green form of pupa, unknown in the natural state, might be obtained. The results were, however, highly irregular, and there seemed to be no susceptibility to the color. The pupæ were, however, somewhat darker than usual, and this result suggested a trial of black surroundings, from which the strongest effects were at once witnessed. The pupæ were, as a rule, extremely dark, with only the smallest trace, and often no trace at all, of the golden spots which are so conspicuous in the lighter forms. These results suggested the use of white surroundings, which appeared likely to produce the most opposite effects. The colors of nearly 150 chrysalides obtained under such conditions were very surprising. Not only was the black coloring-matter as a rule absent, so that the pupæ were light-colored, but there was often an immense development of the golden spots, so that in many cases the whole surface of the pupæ glittered with an apparent metallic lustre. So remarkable was the appearance, that a physicist to whom I showed the chrysalides suggested that I had played him a trick, and had covered them with gold-leaf. These remarkable results led to the use of a gilt background as even more likely to produce and intensify the glittering appearance. . . . The results quite justified the reasoning; for a much higher percentage of gilded chrysalides, and still more remarkable individual instances, were obtained among the pupæ which were treated in this way."

Warning colors are discussed at some length, and many interesting examples and experimental results adduced. There is a decided antithesis between warning and protective colors; as "the object of the latter is to conceal the possessor from its enemies, the object of the former is to render it as conspicuous as possible." It is shown that warning colors are usually accompanied by a nauseating taste, strongly smelling or irritant fluids, etc. Attention is called to the fact that there is a general similarity in the warning colors of all animals, the prevalent patterns being alternating bands of striking colors, and that consequently enemies soon learn not to attack conspicuous and unusually colored animals, because a few experiments have taught them to associate these striking patterns with disagreeable tastes and odors.

In the chapter on mimicry, more examples, we think, might have been introduced. Many startling cases of *Hymenoptera* mimicked by *Diptera* seem to have escaped the author's notice. The classical case of South American heliconids and pierids, long since described by Bates, really merits fuller treatment than it has received on pp. 232, 233.

The work closes with several very interesting chapters on the colors used in courtship. This is perhaps the most interesting portion of the work, as it deals very successfully with a subject about which there is still wide difference of opinion among zoölogists. Poulton takes his stand with Darwin, and maintains that the peculiar colors, appendages, etc., displayed during courtship by one of the sexes (usually the male) in the presence of the other, owe their origin to sexual selection. This differs from the standpoint taken by Wallace, who denies that the so-called secondary sexual characters thus originate. He maintains that they receive their explanation in natural selection pure and simple. It would be difficult, we believe, to explain many of the facts cited by Poulton, notably Peckham's observations on the courtship of spiders, from Wallace's standpoint.

At the end of the book is given a table illustrating the author's classification of animal colors. Although the Greek derivatives to designate the different uses of colors are well chosen, they will probably not be generally adopted. Zoölogists will probably continue to speak of mimetic rather than pseudaposematic and pseudepisematic colors.

The text is provided with sixty six woodcuts and a chromolithographic frontispiece illustrating a remarkable case of mimicry in South African butterflies.

NOTES AND NEWS.

THE College of Physicians of Philadelphia announces that the next award of the Alvarenga prize, being the income for one year of the bequest of the late Senor Alvarenga, and amounting to about a hundred and eighty dollars, will be made on July 14, 1891. Essays intended for competition may be upon any subject in medicine, and must be received by the secretary of the college on or before May 1, 1891.

—A lady, writing to the *British Medical Journal*, says she recently heard a young girl of fourteen years "whistle," as her people called it; but "warble" it really was, for she kept her mouth slightly open, and the lips merely trembled, the notes being formed in the throat, the centre of it working as a bird's does when singing, and the sounds produced were exactly like those of blackbirds and thrushes. She warbled several airs to pianoforte accompaniments faultlessly, and most beautifully modulated; and so powerful were the notes, that her grandmother, who was excessively deaf, could catch every one, without the slightest effort, in another room a little distance off. In the same room some notes were deafening when she poured them out at the *forte* parts. She had been self-taught entirely from "whistling" to her dog and sitting in the window to "warble" to the birds.

—The flora of the Kutais and Tchernomorsk regions, on the eastern coast of the Black Sea, says M. Kuznetsoff in the "Izvestia" of the Russian Geographical Society (*Nature*, Nov. 6), belongs, as already known, to the Mediterranean region of evergreen trees. Next comes the region of West European flora, characterized by the extension of the beech-tree, and offering on the slopes of the mountains the very same subdivisions as one is accustomed to see in the Alps. That region extends over the provinces of Kuban and Terek as far east as the water-parting between the Terek and Sulak Rivers. The territory to the east of it was formerly thought to have a flora more akin to that of Asia, but a distinctly European flora appears again on the eastern slopes

of the Daghestan plateau turned towards the Caspian Sea; while the dry Daghestan plateau itself has a flora decidedly recalling that of the highlands of central Asia. M. Kuznetsoff explains these differences by the moister climate of the Caucasus highlands, due to the proximity both of the Black and of the Caspian Sea. But it may also have a deeper cause. In fact, the plateaus of Daghestan cannot but appear to the orographer as a continuation of the geologically oldest plateaus of Asia Minor, now separated from the main plateau by the relatively much younger chain of the Caucasus. Referring to the vegetation of the Caucasus during the tertiary epoch, when the Caucasus was a vast island surrounded by tertiary seas, M. Kuznetsoff considers that the flora of Daghestan has undergone the greatest change since the tertiary epoch. The floras of both the western and the eastern Caucasus have maintained more of their old characters, owing to less change having gone on in their climate, which has remained moist; and the vegetation of the Black Sea coast, which has a climate very much like that of the Japan archipelago, has retained still more of the aspects it had during the tertiary epoch. Further exploration will be necessary to show how far climate alone can account for the present characters of the flora of the Caucasus.

—Mr. Arthur Winslow, State geologist of Missouri, in his report of the State Geological Survey for October, states that detailed mapping has been continued in the central and south-eastern portions of the State, and about 140 square miles have been covered in Randolph, Howard, Chariton, Johnson, Madison, and St. François Counties. During the first half of the month the examination of the clay deposits of the western central counties was in progress; but during the latter half this work was discontinued temporarily in order to make final additions to other work already nearly completed. This work in these counties will be resumed this month with the hope of completing the field-work there this season. Examination of the mineral waters has been made in the following nine counties, and samples for analysis have been collected: Adair, Schuyler, Macon, Daviess, Mercer, Chariton, Pike, Marion, and Ralls. In the laboratory, analyses have been made of mineral waters and clays, and a number of specimens sent in by outside parties have been determined. For the purpose of preparing a preliminary report upon the coal-industry of the State, inspections have been made in Callaway, Clay, Ray, Johnson, Saline, Henry, and Barton Counties. The survey has many applications for information concerning the coal-deposits of the State, and there are no publications on hand with which to satisfy this demand: hence this preliminary report will be prepared for early distribution. It will not be possible to give in such a report all of the valuable detail as to the distribution and character of the coal beds which the final reports and maps are designed to contain; but it will furnish general information relating to the present condition of the coal-industry and its prospective development, concerning which nothing comprehensive and official is available now. Work has also been in progress in Webster and Greene Counties in extension of what was done there last summer.

—*Nature* announces the death of Dr. Alexander John Ellis, F.R.S. The following notice of his career is from the London *Times:* "Dr. Ellis, whose original name was Sharpe, died at his residence in Auriol Road, West Kensington, on Oct. 28. He was born in Hoxton in 1814, and educated at Shrewsbury, Eton, and Trinity College, Cambridge, of which he was elected a scholar in 1835, and graduated B.A., being sixth wrangler, and first in the second class in classics, in 1837. He was elected a fellow of the Cambridge Philosophical Society in 1837, of the Royal Society in 1864 (being a member of the council for 1880–82), of the Society of Antiquaries in 1870, of the College of Preceptors in 1873, and a life governor of University College, London, in 1886. He was president of the Philological Society during 1872–74, and also 1880–82. He was also a member of the Mathematical Society of London, of the Royal Institution, of the Society of Arts, and honorary member of the Tonic Sol-Fa College. Dr. Ellis was a voluminous author, his works including 'The Alphabet of Nature,' 1845; 'Essentials of Phonetics,' 1848; 'Plea for Phonetic Spelling,' 1848; 'Universal Writing and Spelling,' 1856; 'Early English Pronunciation, with Special Reference to Chaucer and Shakspeare,' 1869–86; 'Glossic,' 1879; 'Practical Hints on the Quantitative Pronunciation of Latin,' 1874; 'On the English, Dionysian, and Hellenic Pronunciation of Greek,' 1877; 'Pronunciation for Singers,' 1877; 'Speech in Song,' 1878; together with numerous other works and tracts on music and phonetics. He received the silver medal of the Society of Arts for three papers in connection with the 'Musical Pitch' at home and abroad."

—The following is a complete list of the papers presented to the National Academy of Sciences, at its meeting in Boston, Nov. 11, 12, and 13: "On the Primary Cleavage Products formed in the Digestion of the Albuminoid, Gelatine," by R. H. Chittenden; "On the Classification and Distribution of Stellar Spectra," by Edward C. Pickering; "On the Relation of Atmospheric Electricity, Magnetic Storms and Weather Elements, to a Case of Traumatic Neuralgia," by R. Catlin; "On the Growth of Children studied by Galton's Method of Percentile Grades," by Henry P. Bowditch; "On Electrical Oscillations in Air, together with Spectroscopic Study of the Motions of Molecules in Electrical Discharges," by John Trowbridge; "Some Considerations regarding Helmholtz's Theory of Dissonance," by Charles R. Cross; "A Critical Study of a Combined Metre and Yard upon a Surface of Gold, the Metre having Subdivisions to Two Millimetres, and the Yard to Tenths of Inches," by W. A. Rogers; "On Evaporation as a Disturbing Element in the Determination of Temperatures," by W. A. Rogers; "On the Use of the Phonograph in the Study of the Languages of the American Indians," by J. Walter Fewkes; "On the Probable Loss in the Enumeration of the Colored People of the United States, at the Census of 1870," by Francis A. Walker; "On the Capture of Periodic Comets by Jupiter," by H. A. Newton; "On the Proteids of the Oat-Kernel," by Thomas B. Osborne; "On the Present Aspect of the Problems concerning Lexell's Comet," by S. C. Chandler; "The Great Falls Coal Field, Montana, its Geological Age and Relations," by J. S. Newberry; "Notes on the Separation of the Oxides in Cerite, Samarskite, and Gadolinite," by Wolcott Gibbs; "On the Relationships of the Cyclopteroidea," by Theo. Gill; "On the Origin of Electro-Magnetic Waves," by Amos E. Dolbear.

—The Brooklyn Institute, through its department of geography, is preparing to open about Jan. 1, 1891, a permanent exhibition of specimens of the best geographical text-books, maps, atlases, globes, reliefs, models, telluria, and other apparatus used in the various countries of Europe and America in their courses of geographical instruction, or required by persons of culture or wealth who equip their libraries with the best geographical material. The plan having been submitted to the foremost educators in this country, to heads of scientific bureaus of the United States Government, and to leaders in business and financial affairs, has received their indorsement, and will have the advantage of their hearty co-operation. The exhibition will be open for one month in the building of the Brooklyn Institute. The collection will then be exhibited for one month in each of the cities of New York, Philadelphia, Boston, Baltimore, Washington, Chicago, St. Louis, and other great centres of population. The entire collection, except loaned specimens, will then be arranged as a permanent exhibition in the building of the Brooklyn Institute. In connection with the exhibition, the Brooklyn Institute is collecting material for a comprehensive report which it will publish regarding the position and methods of geographical instruction in America and Europe. The exhibition will also illustrate lectures to be delivered on the teaching of geography. The exhibition will be free to the public. The collection will be fully catalogued and conveniently arranged for purposes of comparative examination and study. The intention is to illustrate the methods of geographical instruction in all grades, from primary to university, and to give the American public an unequalled opportunity to become acquainted with the best examples of all the various appliances, wherever produced, that are used to illustrate geography. It is desired to make a very prominent department of books that are helpful to teachers of geography. For further information address Cyrus C. Adams, president Department of Geography, Brooklyn Institute, Brooklyn, N.Y.

SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

VOL. XVI. NEW YORK, NOVEMBER 21, 1890. No. 407.

CONTENTS:

SO FAR AS any definite information has reached this country in regard to the discovery by Koch of a cure for consumption, it appears that the announcement of Koch's discovery was somewhat premature, and that his experiments have not advanced so far as he wished before he would, from preference, have published them. But the interest excited has induced him to make a preliminary statement of results in the *Deutsche medicinische Wochenscrift* for Nov. 14. Even now he simply states that the remedy is a brownish, transparent liquid, which must be injected subcutaneously, preferably on the back between the shoulder-blades and the lumbar region. Small doses do not affect the healthy human being; while with tuberculous patients the re-action consists in an attack of fever, which usually begins with rigors. This is accompanied by pain in the limbs, coughing, great fatigue, and often nausea, the whole beginning four or five hours after the injection, and lasting abcut twelve. In case of any tuberculous affection on the surface, local re-actions take place, which in the case of lupus result, after one or more injections, in the falling-off of the lupus-tissue, leaving a clean, red cicatrix behind. The symptoms above described occurred in all cases in which a tuberculous process was present, showing the remedy to be at least an aid to diagnosis. In what way the cure takes place cannot as yet be stated with certainty; but Koch believes that the remedy does not kill the bacilli, but the tuberculous tissue, and that it may be necessary to even resort to surgical aid to remove the dead tissue if the organism affected cannot throw it off. Glandular, bone, and joint tuberculosis were similarly treated, with the same result as in lupus, of a speedy cure in recent and light cases, and slow improvement in others. With consumptive patients the dose had to be still further reduced. The results were, that those in the first stage of phthisis were freed from all symptoms of the disease, and might be pronounced cured, patients with cavities not much developed were improved, and only those with large cavities in their lungs showed no improvement in condition. Relapses may occur, of course. A most important point is the need of early application of the method.

THE AMERICAN FOLK-LORE SOCIETY.

THE second annual meeting of this society will be held in New York City on Nov. 28 and 29, being the Friday and Saturday following Thanksgiving Day. By the courtesy of President Seth Low, LL.D., the sessions will be held in Room 15, Hamilton Hall, Columbia College, Madison Avenue and Forty-ninth Street.

On Friday there will be three sessions for business and reading of papers. At 10 A.M. the council will meet. At eleven o'clock the president, Dr. Daniel G. Brinton, will take the chair, and an address of welcome will be delivered by Professor John S. Newberry, president of the New York Academy of Sciences. The council will then present its report to the society. Reports of officers and committees will be received, and general business will be transacted. At one o'clock the session will adjourn, and the members are invited to a lunch provided by the local committee. At 2.30 P.M. the society will re assemble for the reading of papers. At 8 P.M., by invitation of the New York Academy of Sciences, a joint meeting of the Folk-Lore Society and the academy will be held in the same hall, at which papers will be read.

On Saturday there will be a single session beginning at 10 A.M. The meetings of the society will be open to the public, but only members will take part in the business and discussions.

The following papers are announced to Nov. 17: Rev. W. M. Beauchamp, D.D., "Hiawatha;" Dr. Franz Boas, "Dissemination of Tales among the Natives of North America;" Dr. H. Carrington Bolton, "Some Hawaiian Pastimes;" Dr. Daniel G. Brinton, "The Worship of Astarte in America," and "The Ethnic Side of Folk-Lore;" Mr. A. F. Chamberlain, "Naniboju among the Ojebways and Mississagas;" Rev. Heli Chatelain, "West African Folk-Lore;" Mr. L. E. Chittenden, "Note on an Early Superstition of the Champlain Valley,—the Whip-poor-will;" Mr. Charles F. Cox, "Faith-Healing in the Sixteenth and Seventeenth Centuries;" Mr. Stewart Culin, "Children's Street Games, Brooklyn, N.Y.;" Rev. J. Owen Dorsey, "Siouan Cults;" Mr. George F. Kunz will make an exhibition of rare objects of folk-lore interest; Professor Daniel S. Martin, "Survival of Superstitions among the Enlightened;" Professor Otis T. Mason, "The Natural History of Folk-Lore;" Dr. John S. Newberry, "The Ancient Civilizations of America, Date and Derivation;" Mr. William Wells Newell, "The Practice of Conjuring Noxious Animals as Surviving in the Folk-Lore of New England;" Dr. Frederick Starr, "The Folk Lore of Stone Implements;" Mr. Louis Vossion, "The Nat-Worship among the Burmese;" Mr. Thomas Wilson, "The Amulet Collection of Professor Belucci, Perugia, Italy, and how it came to be made."

The Wellington Hotel, corner of Forty-second Street and Madison Avenue, will take a limited number of members at favorable rates,—rooms from $1 to $2 per day, and meals from $1.50 to $2 per day, the hotel being on the restaurant plan. The Wellington is very conveniently situated, being only one block from the Grand Central Depot, and seven short blocks from Columbia College, while three lines of horse-cars pass its doors. Persons desiring less expensive accommodation will find the Kingsborough, 58 West Thirty-third Street, near Broadway, comfortable at $2 per day (on the American plan).

The committee has made efforts to obtain reduced rates on the railroads centring at New York, but without success, owing to the restrictive regulations of the companies. For further information address the chairman of the local committee, H. Carrington Bolton, at the University Club, New York City.

THE CINQUEMANI "CHRONOLOGE."

THIS is a very singular and interesting contrivance. As described by a correspondent of *Nature*, it is a clock with only one toothed wheel, yet it shows the hours, minutes, days of the week, etc., and strikes the hours and quarters at each quarter of an hour. Moreover, there is an arrangement for repeating the hours and quarters at will. The single toothed wheel spoken of is the escape-wheel, and this propels a pair of pallets and pendulum in the ordinary way. The rest of the work is done in the fall of a small leaden ball, a long chain of these balls being intermittingly elevated, and one of them discharged over a revolving drum each

quarter of an hour. It is interesting to follow one of these balls through the course of its multifarious duties. It first enters a sling in a tape wound over the escape-wheel axle, and it is the weight of this and three other balls (which have been previously deposited in preceding slings) which keeps the escape wheel going. As the wheel turns round, the balls descend, and after a quarter of an hour the lowest will have arrived at a funnel-shaped opening, where it will get liberated from its sling, and fall. It first strikes a lever which enables the drum to move on and discharge another ball into a sling upon the escape-wheel tape. Then, rushing down a tube, it enters a zigzag. It is within this zigzag that the striking of the quarters is performed; for at each of its angles a bell is placed, against which the ball strikes sharply as it passes them. After leaving this zigzag, the ball is projected down another, where it strikes the hours.

As the number of blows to be struck is regulated by a similar contrivance at each zigzag, we will confine our attention to that for the hours. The channel down which the ball passes is vertical to the face of the zigzag. Now, the front or zigzag side of this channel is a moving tape, which carries a little trap. As the tape is always moving, the position of the trap depends upon the time, and the position of the trap also determines the stage of the zigzag upon which the ball will be projected. Thus, when the trap is opposite the sixth stage of the zigzag, the ball will encounter six corners upon its way down, and consequently six blows will be sounded; when the trap is at the top, twelve blows are sounded; and when the trap is at the bottom, no blows are sounded. When the ball leaves the zigzag, it enters a sling at the lowest part of the chain first spoken of, and is intermittingly carried up again to begin its work over again. For repeating the hours and quarters at will, there is a separate reservoir of smaller balls; and, by pulling a handle, one of these can be discharged above the first zigzag; and when it has done its work, it disappears through a hole, which the regular balls cannot penetrate, back to its own reservoir. It may be mentioned, that, in lieu of bells, the hour zigzag has a single vertical sonorous tube for each set of corners. The time, days of the week, etc., are shown by means of tapes carrying pointers suspended over the escape-wheel and another axle.

The inventor, the Rev. Canon Cinquemani, maintains that the simplicity and precision, by reason of the constant force on the escapement of his "chronologe" (which he has patented), render it peculiarly advantageous for missionary and other distant stations, where the assistance of professional clock-makers is not readily procurable.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Mohawk Folk-Lore.

AT various times during the past two years the writer has had opportunity to converse at length with Odjīdjătĕkhă, an intelligent young Indian of the Mohawk tribe residing near Brantford. From him the material given here has been obtained.

The Child and the Bear.—Once upon a time a child was left an orphan. A council of his clan was held to consider what should be done with him, and to decide as to whose care he should be given over. Some one (a woman) asked permission to keep him, but soon after allowed him to get astray in the woods, where he was taken up by a bear (the Indians believe that bears are more loving to their offspring than men). The old she-bear had six cubs, and she made the child the seventh. She lived in a hollow log. One day she was out, and the hunters spied her, and, with four dogs with four eyes apiece, they pursued her, and she was just able to reach her hollow log and crawl into it. The hunters shot her and split the log open, and discovered the six cubs, but where was the seventh? After searching for a while, they found it in the end of the log, all safe and sound, and they were sorry for having killed the bear.

The above story is represented as being told by an old man to children. At the conclusion of it, the child asked, "Why are you so afraid now to let us go into the woods where there are bears, if the bears are so kind?"—"Because our love for you is great, and because of the way in which the child came into the bear's possession."

A Ghost Story.—Dogs are regarded as giving warning of the approach of ghosts, spirits, etc. One day a dog said to a man that at a certain time the ghosts would come for him, and that he must pack up and be off if he did not want them to get him. If he disregarded the dog's warning, he would be lost. He started, and the dogs, one on each side of him, trotted along, and when he was tired carried him on [how they did this the narrator could not say: the Mohawk word used meant simply "carried"]. Behind them they could hear something flying along, and making a great noise like thunder as it came nearer and nearer. It was the spirit; and when it got too near, one of the dogs would go back and fight it, while the other would go along for a while, and then take his turn at fighting back the ghost. By and by one of the dogs got tired, and said to his master that he could not hold out any longer; and he went back, and the master saw him no more. The other dog, however, kept on, and the man reached home, and on arriving fell down on the threshold. A light was seen, and when the crowd gathered round and questioned him, he said, "I've seen a ghost." The Indians are very much afraid of strange lights, believing them to be ghosts.

A Dog Story.—When asked if the Indians ever believed that dogs spoke, Odjīdjătĕkhă said that at Caughnawaga (an Indian settlement in the Province of Quebec), some time ago, a man put his dog out of doors in cold weather. After a while he heard somebody outside saying how cruel and bad it was to keep him out in such very cold weather. He thought it was a man, and opened the door, and saw his dog wagging his tail.

Thunder and Lightning.—The Mohawks believe that thunder is caused by seven men, who are up in the sky. Formerly there were only six of them; but once upon a time an indian got up there, and since then has prevented them from harming Indians. Thus it is that no Indian is ever struck by lightning. When it thunders and lightens very much, the Indians exclaim, "Say, old man, enough of that!"

Weather-Lore.—Among the Mohawks the hog is regarded as a sort of weather-prophet. When cold is about to come on, he carries straw in his mouth to make a nest. When a hog is killed, the people examine something in the inside to see what the weather will be. Every year at the Reservation prophecies are made regarding the weather for the following year, and Odjīdjătĕkhă claims that these are often quite successful. The Indians note a good deal about the weather from trees, and from the actions of various animals and birds, such as the muskrat, the woodpecker, etc.

Feasts, Games, etc.—The Pagan Cayugas and Onondagas still practice their old dances and other rites. The Onondagas have their white dog feast in the spring. There are also the green-corn dance and the fall dance. The dances of the Pagan Indians are celebrated near Brantford towards the end of January.

The chief games of the Indians are, in summer, lacrosse, and in winter the snow-snake. At a sort of religious festival in the "long house," a game of lacrosse is played by women.

The snow-snake is the chief amusement of the Pagan Indians on Sundays in winter. Odjīdjătĕkhă stated that the snake has been thrown by a skilful player to the distance of from 275 to 375 yards. The Mohawk name for the "snow-snake" is *ăgwădrăhōntă*; in Tuscarora, *ūtră hōntă*; in Onondaga, *hăwhōntă*.

A. F. CHAMBERLAIN.

Clark University, Worcester, Mass., Nov. 15.

Mount St. Elias and the Culminating Point of the North American Continent.

THE article on Mount St. Elias which Dr. Dall has communicated to your issue of Nov. 14 calls for a reply. In my paper, "Barometric Observations among the High Volcanoes of Mexico, with a Consideration of the Culminating Point of the North

American Continent, published in the current number of the "Proceedings of the Academy of Natural Sciences of Philadelphia," I give what I believe most unprejudiced critics will consider good reasons for doubting the full accuracy of Mr. Dall's measurements of Mount St. Elias (and Mount Fairweather). The reasons for this belief were republished by the editor of *Science* in the issue of that journal of Nov. 7, and need not be restated; but I may be permitted to add that they were formulated two months before the results obtained by Russell and Kerr were made known, which, unfortunately (for St. Elias), only too clearly prove the justice of my doubt, and fortify my statement that the true position of St. Elias is probably "after, and not before, the Peak of Orizaba."

Dr. Dall seeks to throw discredit on my analysis of his measurements by unfavorably criticising my work in Mexico, but I fail to see the relevancy of the citation. He accuses me of being "no geodesist," which I am pleased to admit; but then I am manifestly not far removed from the company of the distinguished naturalist of Washington, since he also sees fit to confess that he makes "no pretence to the character of a geodetic expert." When, however, Dr. Dall wishes to instruct me in the value and deficiencies of an aneroid barometer, I may perhaps be pardoned for looking to other sources for my information; and I would recommend to my learned friend that he acquaint himself more closely with the analyses of the workings of this instrument made recently by German specialists. I append herewith the results of various measurements made in Mexico, which speak for themselves.

Peak of Orizaba.

	Feet.
Humboldt (trigonometric)	17,375
Ferrer (1796, trigonometric)	17,879
Plowes, Rodrigues, and Vigil (1877, trigonometric)	17,664
Von Müller (trigonometric)	18,112
Ratzel (barometric)	18,069
Kaska (mercurial barometric)	18,045
Kaska (mercurial barometric, more recent)	18,200
Doignon (?)	18,322
Heilprin	18,205

Popocatepetl.

	Feet.
Humboldt (trigonometric, corrected to Mexican R. R. levelling)	17,590
Glennie (barometric)	17,884
Sonntag (trigonometric, with correction to R. R. levelling)	17,660
Heilprin	17,523

Ixtaccihuatl.

	Feet.
Humboldt (trigonometric, corrected to R. R. levelling)	15,702
Sonntag (trigonometric, corrected to R. R. levelling)	16,951
Heilprin	16,960

Nevado de Toluca.

	Feet.
Humboldt (barometric, corrected to R. R. levelling)	15,038
Height given by Garcia Cubas	15,020
Heilprin	14,954

The correspondences and divergences may be considered "merely accidental," if it so pleases the critic; but let us contrast with these Mr. Dall's "observations of a higher class" (as compared with previous measurements):—

Mount St. Elias.

	Feet.
From 69 miles	19,464
From 127 "	18,350
From 132 "	19,956
From 167 "	18,033
Russell and Kerr (1890, as reported in the daily papers) less than	15,000
La Pérouse (1786)	13,000

Possibly the critic will consider these "trigonometrical" results as being also "merely accidental." Mr. Dall wrongly interprets me when he accuses me of broadly stating that the system of "extracting averages" is "delusive." What I object to is the "delusive system of extracting averages." I should perhaps have underscored the first word; but the context, it appears to me, ought to have made my meaning clear. When four measurements of a mountain (Mount Fairweather) give individual results of 15,085, 15,247, 15,447, and 16,009 feet, I fail to see how by any correct system of extracting averages we can obtain "unanimity" in the general result. It is the making of this unanimity which is a delusion to me.

The scientific world will receive with interest the publication of the results of the recent expedition to Mount St. Elias, and I agree with Dr. Dall that it is best to await the official publication before building too high on preliminary newspaper statements.

ANGELO HEILPRIN.

Academy of Natural Sciences, Philadelphia, Nov. 15.

Strawberries.

IT needs little proof to show that a a long-season strawberry is more desirable than one that yields all its fruit within a week. The great bearers are always among those with a long bearing season. A plant, like a person, can do more work in two weeks than in one. What we desire in a good variety is not only a large quantity of fruit, but also a regular supply during a reasonably long fruiting period. As to pollen-production, I do not think that this is quite as heavy a tax upon the vital energies of strawberry-plants as the Ohio Experiment Station tries to make us believe. Undoubtedly it requires some effort, but there is nothing in analogy to show that the process is an exhaustive one. Nature is quite lavish in the production of pollen. While it is true that Haverland, Warfield, and Crescent—all imperfect-flowering varieties—may be safely put down as our most prolific sorts, this fact may be due to mere accident as much as to "division of labor." I have frequently seen the perfect-flowering Sharpless, Pearl, Capt. Jack, even the Wilson, and others, out-yield by a great deal the best on the list of imperfect-flowering (pistillate) varieties. The Long John, a perfect-flowering sort which originated here twenty or more years ago, has for the past two years equalled, or rather out-yielded, even the far-famed and truly wonderful Haverland.

T. GREINER.

La Salle, N.Y., Nov. 12.

Structure of the Plesiosaurian Skull.

IN his recently published "Manual of Paleontology" (p. 1067) Lydekker makes the statement, in his definition of the *Lynaptosaurian* branch, that there are "no ossifications in the sclerotic of the eye," and repeats it in his yet more recent "Catalogue of Fossil Reptilia." Upon this authority, I stated in my recent letter to *Science* that sclerotic plates had not been previously described for this branch, including the *Chelonia* and *Sauropterygia*. This is not correct, as Dr. Baur kindly informs me. He says, "Sclerotic plates are present in the *Testudinata*, as mentioned by Huxley and Hoffmann. I have found them in *Pleurodira*, *Cryptodira*, and *Trionycha*."

I do not wish to say that this character, and certain other ones, such as the co-ossification of the jaws, absence of parietal foramen, etc., are of high classificatory value, but rather that their discovery will require a revision of definitions hitherto given.

S. W. WILLISTON.

Lawrence, Kan., Nov. 12.

AMONG THE PUBLISHERS.

THE issue of *Garden and Forest* for Nov. 12 opens with an article on the use of the axe in plantations of ornamental trees. This is followed by an illustrated account of some insect enemies of fruit trees, by Professor Smith, entomologist of the New Jersey Experiment Station. *Celastrus articulata*, a Japanese relative of our climbing bitter-sweet, is described by Professor Sargent, and an excellent figure of the plant accompanies the description. Mrs. Treat writes instructively of evergreens in the pine barrens of New Jersey; and articles on chrysanthemums, asters, and other late-flowering plants, help to make the number seasonable and attractive to every lover of a garden.

— The first edition of "Scientific Lectures," by Sir John Lubbock (London and New York, Macmillan), appeared in 1879. The second edition, now before us, is, so far as we are able to judge, but a reprint of the former. The subjects treated are flowers and insects, plants and insects, the habits of ants, and an introduction

to the study of prehistoric archæology. The volume also contains an address to the Wiltshire Archæological and Natural History Society, and an inaugural address to the Institute of Bankers. Although more than ten years have passed since the first edition was published, the subjects have lost none of their freshness, nor has the manner in which they are handled lost any of its charm or interest.

— *The Chautauquan* for December includes the following articles: "The Intellectual Development of the English People," by Edward A. Freeman; "The English Constitution," III., by Woodrow Wilson, Ph.D.; "How the Saxon Lived," Part III., by R. S. Dix; "The Tenure of Land in England," Part III., by D. McG. Means; "An English Scholar of the Middle Ages," by Eugene Lawrence; and "Studies in Astronomy," II., by Garrett P. Serviss.

— "A Chart of English Literature," edited by George Edwin Maclean, Ph.D., has appeared from the press of Ginn & Co. It is an outgrowth of Professor Maclean's experience in the class-room with a number of classes in the history of English literature, and is, in fact as in name, only a chart, making no pretension to the greater measure of completeness pertaining to the purposes of tables of literature. It covers the whole field, nevertheless, is practical, and will prove useful to students of literature.

— The *Nineteenth Century* for November (New York, Leonard Scott Publication Company) maintains the reputation of this review as the leading English periodical. It opens with a paper by Mr. Gladstone, entitled "Mr. Carnegie's Gospel of Wealth: a Review and a Recommendation." In this article Mr. Gladstone reviews Mr. Carnegie's theories on the use of wealth, and urges the re-establishment of Lord Carlisle's Universal Beneficent Society,—an organization started some twenty-five years ago. In an article on "The Aryan Question and Prehistoric Man," Professor Huxley examines the question of the antiquity of man from a biological standpoint, and finds traces of human existence at a very early time. Prince Krapotkin continues his studies in mutual aid among animals, and brings together many curious illustrations of mutual regard among the lower members of the animal kingdom. Henry Wallis writes on the destruction of Egyptian monuments, which he justly regards as one of the disgraces of our time. He gives a faithful picture of the incalculable damage now being done to some of the most interesting relics of a past civilization. The Hon. Emily Lawless begins a series of papers on old Irish chronicles, the first instalments being devoted to telling the story of the life of Gerald Mor (Gerald the Great), one of the most picturesque figures in Irish history. Dr. J. Paul Richter writes on the guilds of the early Italian painters, and presents a novel picture of the training of artists in the middle ages in Italy. Professor F. T. Palgrave of Oxford contributes an essay on the Oxford literary movements of the fifteenth century, tracing the importance of Oxford in the development of English literature. Three writers briefly discuss the question of the private soldier's wrongs, from as many standpoints. Right Rev. Bishop Barry presents a plea for the loyal feeling in the English colonies, in an article on "The Loyalty of the Colonies." R. E. Prothero writes on French boycotting and its cure. The Right Rev. Earl Grey begins a series of brief political articles entitled "In Peril from Parliament."

—An office has been established in the National Department of Agriculture, one function of which is to collate the work of the agricultural experiment stations of the country, and republish such portions as are of greatest immediate importance in a special farmers' bulletin. The second issue of this bulletin, recently published, contains accounts of experiments on the following subjects: "Better Cows for the Dairy,"—a description of an experiment made by the Massachusetts station, in which records have been kept of the feed consumed and milk produced by twelve cows of different breeds, the experiment extending over five years (it is shown, that, if no allowance be made for the value of the manure, the best cow in the test gave a profit of thirty-six dollars, while the poorest one, with her feed, cost thirty-four dollars more than her produce was worth); "Fibrine in Milk,"—an account in which Dr. Babcock of the Wisconsin station has shown that there is a substance in milk akin to the fibrine or clot of blood, and that this substance plays an important part in butter-making; "Bacteria in Milk, Cream, and Butter,"—the substance of reports of an investigation made on behalf of the Storrs School station of Connecticut, in which it is shown that these minute organisms, which are found everywhere in the atmosphere, are the immediate cause of the souring of milk, and that milk may be handled with much greater economy by understanding the nature of bacteria; "Silos and Silage,"—a digest of experiments made at the stations of Kansas, Ohio, Michigan, Illinois, and New York; "Alfalfa,"—a report giving full directions for the culture of this plant, with its value as a fertilizer and as food for stock. This summary gives an idea of the contents of these bulletins, which are published for free distribution among farmers, and will be sent to any farmer on request. Address Office of Experiment Stations, Department of Agriculture, Washington, D.C.

—The *American Journal of Archæology and of the History of the Fine Arts*, Vol. VI. (1890), will contain among its articles of interest the following: "Hittite Sculptures," and "Oriental Antiquities," by Dr. William Hayes Ward of New York; "Antiquities of Phrygia," by Professor William M. Ramsay of Aberdeen, Scotland; "Terra-cottas in American Collections," by Salomon Reinach, Museum of Saint-Germain, France; "Reminiscences of Egypt in Doric Architecture," by Professor Allan Marquand of Princeton; "Three Heads of Zeus, Hades, and Poseidon, of the Hellenistic Period," by Professor Adolph Michaelis of Strassburg; "Excavations and Discoveries made by the American School of Archæology at Anthedon and Thisbe in Bœotia, Greece," by Professor F. B. Tarbell of Harvard University, and Dr. J. C. Rolfe of Columbia College; "Greek Sculptured Crowns and Crown-Inscriptions," and "Distribution of Hellenic Temples," by Dr. George B Hussey of Princeton; "Norms in Greek Architecture," by Professor Marquand and Dr. Hussey; "The Recently discovered Early Christian Palace under SS. Giovannie Paolo, at Rome," by Padre Germano of the Order of Passionists; "The Lost Mosaics of Rome from the Fourth to the Ninth Century," by Eugene Müntz of the Beaux-Arts, Paris; "Cistercian Monuments as the Earliest Gothic Constructions in Italy," "Roman Artists of the Middle Ages," "Christian Mosaics," and "Tombs of the Popes at Viterbo," by Professor A. L. Frothingham, jun., of Princeton. Being the organ of the Archæological Institute of America, and the medium of direct communication from the American School at Athens, this work has an increasing popularity among general readers as well as specialists.

—In the *Fortnightly Review* for November, issued in this country by the Leonard Scott Publication Company, New York, the new story by Count Leo Tolstoi is brought to a conclusion. An article by Moreton Frewen on "The National Policy of the United States" treats of the recent tariff legislation in this country. The author thinks the McKinley Bill may lose Great Britain Canada, but that it is more likely to cement a Greater Britain not alone of Canada, but also of Australia and South Africa. Sir Lepel Griffin, who published a series of papers on America in the *Fortnightly* a few years ago, writes on "The Burman and his Creed," describing religious life in Burmah and the religious feelings among the natives. Frederick Greenwood, the former editor of the *Pall Mall Gazette*, contributes a careful forecast of the political future of England in an article entitled "The Coming Session: Breakers Ahead." An address delivered to the Chamber of Commerce at Liverpool by H. H. Johnston, on "The Development of Tropical Africa under British Auspices," contains much information as to the possibilities of the Dark Continent and its value to civilized nations. Madame James Darmsteter continues her studies in French medieval life in a paper on "Rural Life in France in the Fourteenth Century," in which she brings together many curious items relating to daily life in the middle ages. A paper by Felix Volkhowsky on his life in Russian prisons presents a lifelike picture of existence in Russian prisons by one who spent seven years in solitary confinement and eleven years as an exile in Siberia. This is a thrilling account of actual prison life in Russia, and will doubtless command wide attention. W. H

Mallock continues his duel with Father Sebastian Bowden on reason and religion in a paper entitled "Reason Alone." Algernon Charles Swinburne contributes a notice of the life and works of the old English poet, Robert Davenport. The number closes with the second instalment of George Meredith's new novel, "One of Our Conquerors."

— One of the most recent additions to the American Book Company's list of schoolbooks is "The Natural Speller and Word Book." The word "natural" in this connection, we presume, relates to an important principle recognized in the higher branches, but too long neglected in the beginnings of school education. In the higher branches this principle is acted upon in showing the intimate relation existing between the various subjects taught, as mathematics, physics, astronomy, chemistry, etc. In this book an effort is made in the same direction by showing the relationship between the words in each lesson. As stated in the preface, "there are a certain number of useful words which the pupil must learn in any event. The question therefore arises whether it is of more benefit to teach him these words abstractly, or to combine them into various exercises which will prove both interesting and instructive." The latter plan has been adopted in this work, and the idea has been well worked out. In addition to the usual methods of calling attention to special letters and combinations by means of bold-faced type, etc., the use of red ink has been tried, and, in our opinion, with unsatisfactory results.

— "Smithsonian Miscellaneous Collections," No. 741, is an "Index to the Literature of Thermodynamics," by Alfred Tuckerman, Ph.D. This is similar to the author's "Index to the Literature of the Spectroscope," published in the thirty-second volume of the same collection for 1888. All of the titles are given in full in the author-index; but in the subject-index, to save useless repetition, only the authors and the places where their works are to be found are given, except in the case of books. Applications of thermodynamics have been found, and kept, to the number of more than double the titles given, but they were omitted so as not to overload the index with matter of little or no use No titles, however, have been left out which belong to the applications named in the table of contents. The work has been brought down to the middle of the year 1889.

— "A Woman's Trip to Alaska" is the title of a volume of travels which the Cassell Publishing Company will issue in a few days. The woman who made the trip is Mrs. Septima M. Collis, the wife of Gen. C. H. T. Collis of New York.

—The American publishers of the *Contemporary Review*, the Leonard Scott Publication Company, announce that the November number of that periodical will contain an important note on the personal relations of Stanley and Emin Pacha by Dr. Carl Peters, who gives Emin Pacha himself as the authority for his statements. Josephine Butler will write a graceful tribute to Mrs. Booth, the mother of the Salvation Army, not only describing Mrs. Booth's own part in building up the work of that organization, but pointing out the great good it has accomplished. Arnold White will tell the story of some recent experiments in colonization as gathered from his own observations in South Africa. George Bartrick Baker will contribute a paper on "The Late Crisis on the Stock Exchange," in which he will undertake to point out the causes which have led to the present stringent condition of the money market. Justin McCarthy will review Mr. Lecky's last volumes, the concluding portion of his "History of England in the Eighteenth Century," which are chiefly devoted to the study of the Irish Union. Mrs. Millicent Garrett Fawcett will write on "Infant Marriage in India," and detail the actual life of a Hindoo woman from her cradle. Rev. Dr. Edwin A. Abbott will have a thoughtful and interesting essay on "Illusion in Religion." Sir Thomas H. Farrer will continue his examination into the methods of imperial finance for the last four years. Vernon Lee's Story, "A

Worldly Woman," will come to a conclusion; and Irish politics will receive consideration in a paper on "The Irish Land-Purchase Bill," by William O'Connor Morris, and a review of the proposed remedies for Irish distress by Michael Davitt.

—A pamphlet has been published in Washington on the subject of "Manual Training in the Public Schools of the District of Columbia." It is purely descriptive in character, and gives a careful and somewhat minute account of the various exercises that have been adopted at the national capital for imparting the training in question. The exercises here described are exclusively for boys, and embrace many kinds of operations in both wood and metal work, as well as in drawing. They are more difficult than some that we have seen described, and demand for their performance a considerable degree of mechanical skill. The text is illustrated by a large number of diagrams, which show better than description can the real character of the work done; and the pamphlet will doubtless be useful to all who are interested in its subject.

—*Scribner's Magazine* during the coming year will publish, among other matter not hitherto announced, "Papers on Japan," by Sir Edwin Arnold (completing the series to be begun in the December number under the title "Japonica"), illustrated by Robert Blum, who was commissioned by the magazine to visit Japan for the purpose, and co-operate with the author. Another literary and artistic contribution to this subject, also illustrated by Mr. Blum during his residence at Tokio, will be two articles by John H. Wigmore, professor in the Tokio University,—one on the popular aspect, and especially on the general celebration, of the inauguration of the new constitution and political order in Japan; and the other on the new parliament and other bodies which are to carry it into effect. Professor James Bryce, M.P., the well-known English publicist, and author of "The American Commonwealth," will write four articles upon India, embodying the results of his recent journey and a careful study of the country in its social and political aspects, both in itself and its relations to the British Empire. Henry M. Stanley will make an important contribution on an African topic (entirely distinct from his book), with noteworthy illustrations; several papers will also be published, continuing the general subject of Africa, upon which the magazine has printed during the past year, in Mr. Stanley's only article, and in papers by Thomson, Drummond, Ward, and others, the most important articles that have appeared. In an early number will be printed an article by J. S. Keltie, summarizing, with the aid of the African Exhibition just held in London, the great events in the history of African exploration, with a large number of unique illustrations from objects, portraits, etc., lent by explorers and their representatives. There will also be published in the magazine "Latest Explorations of Dr. Carl Lumholtz" (the explorer, and author of "Among the Cannibals"),—papers giving the first account, and the only one to be published in any periodical, of the expedition upon which he is now engaged in a comparatively unexplored region of northern Mexico, in which, it has long been believed by the best authorities, may be discovered descendants of the primitive cave-dwellers and the foundations of the oldest American civilization; several articles upon Australian topics (including "Glimpses of Australia," by Josiah Royce; an article upon the railways of Australia, which, as examples of successful government control, present many novel features; an article on Kangaroo hunting by Birge Harrison; and others); "Ocean Steamships," a short series of fully illustrated articles (somewhat similar, in point of view and treatment, to the railway articles which excited so wide an interest in the magazine in 1889) upon their management, the life and travel upon them, etc.; and "The Seashore,"—four papers by Professor N. S. Shaler, with very copious and rich illustrations from the collections of photographs and drawings, both of the Atlantic and Pacific coasts, made by the author during the last twenty years.

CALENDAR OF SOCIETIES.

Biological Society, Washington.

Nov. 1.—F. V. Coville, Fruiting of the Ginkgo at the Department of Agriculture; George Marx, Investigations of the Poison Glands of Lathrodectus; Joseph F. James, Fucoids and other Problematic Organisms.

Nov. 15.—C. Hart Merriam, Life of the Lava-beds and Cañons of Snake River, Idaho, in October; Theo. Holm, The Vegetative Propagation of Dicentra cucullaria; W. H. Dall. Paleontological Notes from the Northwest Coast; F. A. Lucas, A Foot-Disease of Captive Birds.

New York Academy of Sciences.

Nov. 10.—Alexis A. Julien, On the Microbe of Phosphorescent Wood (illustrated by microscopic preparations).

Boston Society of Natural History.

Nov. 19.—Nathan Appleton, Santo Domingo (illustrated by the stereopticon).

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—There being a considerable annual income for the purchase of books for the Museum Reference Library of Iowa College, it is desirable to have at hand any and all circulars, specimen sheets, catalogues, etc., of all works on Natural History in general, both foreign and domestic. Circulars of museum supplies, apparatus, etc., etc., desired also. State terms. Address ERWIN H. BARBOUR, Box 1333, Grinnell, Iowa.

WANTED.—A situation as Analytical Chemist is desired by the assistant of the late noted scientist, Dr. Cook, during his 15 years survey of the State of New Jersey. Highest testimonials furnished. Address Prof. EDWIN H. BOGARDUS, New Brunswick, P. O. Box 224, care Prof. F. C. Van Dyck.

WANTED.—To purchase a complete set, or single numbers, of Loomis' contributions to meteorology, published in the *American Journal of Science*. Address communication, stating price, to FRANK WALDO, Mountain Lake Park, Garrett Co., Maryland.

COULD some one inform me what the ingredients and origin of asphalt as used for street-paving and gathered at Trinidad are? Also how gathered and shipped by natives, and mode of refining by the Warren-Scharf Co. of New York and the Barber Co. of Washington? G. KNIPER, 28 Gunn Block, Grand Rapids, Mich.

WANTED.—A position in a Normal School or College as teacher of Botany, Physiology, Zoology, Embryology, Chemistry, Physics, or German, by a university graduate who has done special work in the above lines. Several years' experience in teaching, and one year as assistant in Biology in a prominent university. Box 396, Greencastle, Ind.

PROFESSOR W. M. DAVIS, Harvard College, Cambridge, Mass., desires to correspond with professional and amateur photographers, from whom he can obtain views of New England landscapes.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I wish to exchange Eastern *Lepidoptera* for those that I do not have, particularly those found in the South. Jos. F. Crandall, Honesdale, Wayne Co., Pa.

To exchange, 1890 Seeger and Guernsey Cyclopedia, containing a complete list of the manufactures and products of the U. S., and address of first hands, cost $6. David R. Lewis, Saybrook, Ill.

For exchange—Nice specimens of Unios alatus, trigonus, parvus, occidens, anadontoides gibbosus, rectus, verucosus, gracilis coccineus, ventricasus, multiplicatus and plicatus cornutus. Margaritana confrogosa, complanata, rugosa. Anadonta edentula, decora, corpulenta, and about 300 of the beautiful Ana. suborbiculata. Wanted: Unios from all parts of the world, and sea-shells. Address Dr. W. S. Strode, Bernadotte, Ill.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
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THE INTERMARRIAGE OF THE DEAF, AND THEIR EDUCATION.

AN intimate acquaintance with deaf-mutes for more than fifty years, and active labors among them as a teacher for nearly thirty-five years, may, perhaps, justify me in asking to be allowed to take part in the discussion concerning the deaf to which *Science* has recently opened its columns; and the two points on which I have a word to say are (1) the intermarriage of the deaf, and (2) their education.

I think that in considering the first point an important fact has been overlooked; namely, that with a large proportion of the persons commonly spoken of as "deaf-mutes" there is no more likelihood of giving the legacy of deafness to offspring than with perfectly normal people. Professor Bell, who stands as the most pronounced opponent of deaf-mute intermarriages, makes this clear in his testimony before the Royal Commission (*Minutes of Evidence*, p. 817). "No one," he says, "desires to bring misfortune on his offspring, and, if the deaf were so classified as to distinguish those who would be likely to transmit their defect from those who would not, many of the more intelligent of our pupils might avoid forming unions that would increase the chances of their having deaf children." Dr. Bell then gives in a footnote the following classification:—

Classification of the Deaf into Four Groups as a Guide to Marriage.

Period of Life when the Deafness occurred.	Character of the Deafness.	
	Sporadic deafness.	Family deafness.
Before birth (congenital).	2	4
After birth (non-congenital).	1	3

And he says, very truly, that "persons belonging to Class 1 do not manifest a tendency to transmit the defect to their children." This class consists of those who, born normal infants, and having no deaf-mute relatives, are made deaf by some one of the many diseases which affect the auditory organs, or become deaf through accident. It is not easy to determine absolutely the proportion this class bears to the whole number of deaf-mutes, but it is undoubtedly over fifty per cent; for our statistics show that sixty per cent of the whole number of deaf-mutes are known to have lost hearing from disease or accident, and there is a strong presumption that many reported as born deaf became so after birth at so early an age as to lead parents to suppose erroneously that they were born deaf. Making due allowance, then, for the cases believed to be comparatively few in number, classified by Dr. Bell under "Family Deafness after Birth," which could not be regarded as normal, it is safe to say that fully one-half of the deaf and dumb (to use a term now regarded as old-fashioned by many), have, according to Dr. Bell himself, no tendency to transmit their defect to their children. Among this half, therefore, intermarriages may occur without fear that deaf offspring will appear in any greater proportion than in the community at large; and those who oppose the marriage of the deaf among themselves should give due consideration to this very important fact. On the other hand, those who favor the unrestricted intermarriage of the deaf, most prominent among whom is your latest contributor in this discussion, Dr. Gillett of Illinois, should, I think, give more weight than they seem disposed to do to the acknowledged facts that marriages between two persons belonging to Dr. Bell's Class 4 are likely to result in a very large proportion of deaf children; that in marriages between persons belonging to Classes 2, 3, and 4 this tendency is decided; and that even in a marriage of persons belonging to Classes 1 and 2 this tendency is greater than among the general population. With many of Dr. Gillett's views, recently expressed in *Science*, I agree, and I honor him as one who has given a life of effective and unselfish labor to the cause of the deaf; but I think he errs radically in characterizing total deafness as "only a serious inconvenience;" and I am sure few hard-of-hearing persons even, much less those absolutely without hearing, will allow him to classify their infirmity with baldness or near-sightedness.

Deafness is certainly a grave misfortune, and those in whose person or in whose family it inheres are bound by altruistic considerations to take care that by no selfish act or course of theirs the aggregate of this misfortune in the world shall be increased. The deaf-mutes resident in the vicinity of Boston have lately discussed the subject of marriage, and have protested publicly against the attitude taken by Dr. Bell. They have disputed his claim that among the offspring of such marriages a large proportion of deaf children will be found; and one of their number, Mr. E. W. Frisbee,—an intelligent and worthy young man,—has taken pains to gather and publish statistics which he thinks sustain the views held by the Boston deaf-mutes. But unfortunately Mr. Frisbee is "hoist with his own petard:" for he says (in the *Deaf-Mute's Journal*, New York, Nov. 6), that, "among 103 children born of deaf-mute parents in Boston and vicinity, *only* 14 are deaf-mutes," naïvely ignorant that he is giving Dr. Bell heavy and effective ammunition.

But even with this unexpected aid from the opposing side, I do not think Dr. Bell's views are to be accepted as those which should govern the deaf, in all cases, in their choice of partners for life. Much less do I approve of the wholesale encouragement to deaf-mute intermarriages given by Dr. Gillett.

Were my advice sought by a young deaf-mute, heart-free, and untrammelled by any engagement, I should say that if he or she could marry, on a basis of sincere affection, one possessed of hearing, such a union would be far more to be desired than one with a deaf partner. Such a marriage as I would recommend first would do much towards taking the deaf partner out of the narrow circle of deaf-mute society, with which the deaf are too apt to be content; it would bring a most important element of comfort and practical assistance to the married pair; it would furnish an essential advantage in the training of the children and in the management of the household. But no argument ought to be necessary to prove that a family where one parent can hear has great advantages over one where both parents are deaf; and in the last analysis the interest of the family must take the precedence over that of the individual, for it is the family, and not the individual, that constitutes the unit of society. Many deaf-mutes think more happiness is to be found in a marriage with a deaf person than with one who hears; but this is by no means as certain as Dr. Gillett, or the deaf themselves, suppose, for it involves a question that has not yet been settled, and may never be. I have known some intermarriages of the deaf to result in wretched unhappiness, but I do not for that reason conclude that such marriages must always, or even often, be unhappy. It is undoubtedly true that some marriages of deaf people with those who hear have turned out badly, but Dr. Gillett's admission that he has known "most beautiful and happy unions of this kind" is a sufficient answer to all objection to such unions; and to his admission I may be permitted to add the testimony from experience, of both a son and a brother, that marriage between the deaf and the hearing may be entirely happy and essentially successful.

But I would not have my deaf friends who have intermarried feel that I am putting them under a wholesale condemnation by urging the union of the deaf with the hearing as the ideal marriage for them. I am perfectly aware that circumstances may arise under which it becomes extremely difficult for a deaf person *not* to take a deaf partner. I am old-fashioned enough to believe in falling in love, even in this mercantile age, and in remaining in love through long years of happy married life; and I should be the last to lay a rude hand on a tie that had grown up between two deaf young people which seemed likely to ultimate in that greatest of Heaven's boons, a marriage of sincere affection. In such a case my friendly advice would be to look well into the causes which made the young people deaf, and ascertain whether there was a family tendency towards the disability or not; and if it appeared that no such tendency existed, or that it was very slight, I certainly should not "forbid the bans."

If, on the other hand, such a condition in the families was disclosed as to render the birth of deaf children probable, a reason for hesitation would surely be recognized which every truly benevolent and unselfish mind would regard as serious.

I have several personal friends who have remained unmarried because of the existence in their families of certain mental or physical defects likely to descend to offspring; and as I honor them for their unselfishness, so would I rank high in my esteem a deaf person who lived single for a similar reason. But the consideration of this aspect of the question need not be extended: it can be dismissed with the advice to all young deaf people to look carefully into the matter of "family deafness" before their hearts become entangled with any one, and govern themselves accordingly, remembering all the time that their ideal marriage, because best for the family, is with one who hears.

Turning now to the second point proposed for consideration in this article, the education of the deaf, I desire to direct attention to several errors which have of late attained popularity and credence, as supposed truths, with many people: —

1. That the oral teaching of the deaf is a new method.
2. That all deaf children can be successfully taught to speak.
3. That under the oral method deaf children can be taught the vernacular use of language more easily and perfectly than under the manual method.
4. That the use of the sign-language is a hinderance to the best results in teaching the deaf.
5. That signs can and ought to be dispensed with in educating the deaf.
6. That the sign-language obtained a foothold in this country merely through accident.
7. That it is now dying out.
8. That the oral method is greatly superior to the manual, and is rapidly supplanting it.

So far from its being through accident that the sign-language obtained a foothold in this country, the facts are, that the founder of deaf-mute instruction in America, Thomas Hopkins Gallaudet, sought for many months in England to gain a knowledge of English methods of teaching the deaf which made little use of signs; that the schools of Great Britain were closed against him; that, while he stood patiently knocking at their doors, he met in London the distinguished French teacher of the deaf, the Abbé Sicard, and his talented pupil, Laurent Clerc; that on Sicard's invitation Mr. Gallaudet repaired to Paris, where he found the manual method of De l'Epée, which made free use of the sign-language, in most successful operation; that he acquired a knowledge of that method, believing, with good reason, that it was well adapted to secure the education of all the deaf; that he introduced that method into America, where it has been preserved from 1817 to the present time, with results to thousands of deaf children more beneficent and satisfactory, on the whole, than have attended the education of the deaf in any other country under any method.

The sign-language, far from dying out in this country, is to-day made use of in a greater number of schools, and with a larger number of pupils, than it has been in any year since its introduction seventy-three years ago.

The first oral school in America in which it was undertaken to dispense with signs was established in 1867, when the number of schools for the deaf was thirty. Since that time fifty-one schools have been established in the United States and Canada, having 2,157 pupils. In thirty-five of

these the sign-language is constantly and freely used as a means of instruction. In sixteen, the oral schools, with 777 pupils, the sign-language is said to be dispensed with in teaching, but is known to be largely used by the pupils when not under the surveillance of instructors or officers. In not one of the thirty schools existing previous to 1867, in which 5,869 pupils are now taught, has the use of the sign-language been abandoned. These thirty schools in 1867 had less than 3,000 pupils.

The latest statistics report 9,325 deaf children under instruction in the United States and Canada in eighty-one schools. The number of oral schools from which it is attempted, with partial success only, to exclude the sign-language, is eighteen, with 1,113 pupils,—less than one-fourth of the schools, and less than one-eighth of the pupils.

These facts certainly lead to other conclusions than that the sign-language is dying out in America, and that the oral method is supplanting the manual.

No error can be greater than the supposition that the judicious use of the sign-language is a hinderance to the best results in teaching the deaf. Proofs to the contrary abound in the history of the manual schools of America. The sign-language, far from being a hinderance, is a most important, valuable, and sometimes even an indispensable, adjunct in teaching; and, where well-trained and competent instructors are employed, the results are far more satisfactory than under the method which rigidly excludes signs; and it is not alone under the manual method or by manual teachers that the value of signs is recognized.

But before bringing forward the testimony of one of the world's most famous oral teachers of the deaf in favor of the use of signs, even in oral schools, I wish to direct attention to, and emphasize, the fact that those who are loudest in traducing the language of signs and in demanding its abolition from schools for the deaf, who assume to discourse learnedly as to its baneful effects, have never even attempted to learn it, and could not hold five minutes' conversation in it to save their lives; and yet their pupils know and use this language, and may insult or ridicule them in it under their very noses with impunity.

If one as ignorant of French or German as these critics are of the sign language should undertake to enlighten the world as to the effect on mental development of studying and using the language of France or Germany, I think the world would be apt to be amused.

In 1867 I made an extensive examination of the prominent schools for the deaf in Europe. Among others, I visited the renowned establishment at Weissenfels, an hour's ride from Leipzig, where the first oral school for the deaf was established, in 1772. At the head of this school I found Frederick Moritz Hill, then in his sixty-second year, and in the thirty-seventh year of his service as a teacher of the deaf under the oral method. As a writer of works relating to the education of the deaf, as a teacher of deaf children, and as a trainer of teachers, Hill occupies a place second to none among the instructors of the present century. In 1866 he published his most important work, "Der gegenwärtige Zustand des Faubstummen Bildungswesen in Deutschland," to which he called my attention as expressing views he had formed after nearly forty years of teaching.

From this work I will make a few extracts, giving the opinions as to the value of signs in the instruction of the deaf of a high priest of oral teaching in the land where oralism came into being, and where it has been universally upheld and practised, with all the success of which it is capable, to this day.

Speaking of those who pretend that in the "German method" every species of pantomimic language is proscribed, Hill says,—

"Such an idea must be attributed to malevolence or to unpardonable levity. This pretence is contrary to nature, and repugnant to the rules of sound educational science.

"If this system were put into execution, the moral life, the intellectual development, of the deaf and dumb, would be inhumanly hampered. It would be acting contrary to nature to forbid the deaf-mute a means of expression employed by even hearing and speaking persons. . . . It is nonsense to dream of depriving him of this means until he is in a position to express himself orally [p. 88]. . . . Even in teaching itself we cannot lay aside the language of gestures (with the exception of that which consists in artificial signs and in the manual alphabet, two elements proscribed by the German school),—the language which the deaf-mute brings with him to school, and which ought to serve as a basis for his education. To banish the language of natural signs from the school-room, and limit ourselves to articulation, is like employing a gold key which does not fit the lock of the door we would open, and refusing to use the iron one made for it. . . . At the best, it would be *drilling* the deaf-mute, but not *moulding* him intellectually or morally. Where is the teacher who can conscientiously declare that he has discharged his duty in postponing moral and religious education until he can impart it by means of articulation? Although the use of the language of pantomime acts in several respects in an unfavorable manner on the teaching of articulation, it ought to be remembered that institutions for the deaf and dumb are not created solely to impart this latter kind of instruction: their object is much more extensive, and they have to meet wants which depend on education taken in its entirety. It would therefore be a fault to exclude prematurely the language of natural signs [pp. 89, 90].

"I have always expressed myself thus when giving my exposition of the value and mode of applying, as a means of instruction, this language which we possess; and I have done this, I believe, without equivocation. I acknowledge in this language of natural signs —

"1. One of the two universally intelligible innate forms of expression granted by God to mankind,—a form which is in reality more or less employed by every human being.

"2. The only form of expression which by the deaf-and-dumb child can be fashioned without the aid of extraordinary practice, just as his mother-tongue suffices to the hearing child, eventually arranging itself into forms of thought, and unfolding itself into spoken language.

"3. The reflex of actual experiences.

"4. The element in which the mental life of the deaf-mute begins to germinate and grow,—the only means whereby he, on his admission to the school, may express his thoughts, feelings, and wishes.

"5. A very imperfect natural production, because it remains for the most part abandoned to a limited sphere of haphazard culture.

"6. A valuable mirror for the teacher, in which the intellectual standpoint of his pupil is exhibited to him.

"7. At first the only, and consequently indispensable, means of comprehension between teacher and pupil, but not a language which we merely need to translate into ours in order to induct him into the latter tongue.

"8. An instrument of mental development and substantial instruction, made use of in the intercourse of the pupils with each other; for example, the well-known beneficial influences which result from the association of the new pupils with the more advanced.

"9. A means, but not the only one, whereby to supply a lack of clearness in other methods of communication, and leading back, in extraordinary cases, to the real object, or to its representation in drawing or model.

"10. The most convenient, quick, and certain means, in many cases, of making one's self understood by deaf-mutes, whether during tuition or out of school hours, and therefore also employed, perhaps, very often without need, even without volition.

"11. A very welcome means of revisal and correction when articulation brings into use, for example, an ambiguous word.

"12. A most efficacious means of assisting even pupils in the higher degrees of school training, giving light, warmth, animation, to spoken language, which, for some time after its introduction, continues dull and insipid.

"13. A practicable means of communication with others beyond the walls of the deaf-and-dumb institution, whether it be used by itself or in connection with articulation."

Then, after extending somewhat the train of thought suggested by these clearly stated points, the author thus concludes what he has to say in this part of his book on the use of signs: —

"But it is particularly in the teaching of religion that the language of pantomime plays an important part, especially when it is not only necessary to instruct but to operate on sentiment and will, either because here this language is indispensable to express the moral state of man, his thoughts, and his actions, or that the word alone *makes too little impression on the eye of the mute* to produce, without the aid of pantomime, the desired effect in a manner sure and sufficient."

The only comments necessary on Hill's conclusive argument in favor of the sign-language are (1) that his single criticism in Paragraph 5 loses its weight altogether when manual or combined schools are considered; for in these the sign-language, far from being "abandoned to a limited sphere of haphazard culture," as is the case in the oral schools where it is used at all, has had a century and a half of careful and often scientific development, and now serves as a medium for expressing and receiving abstract ideas, the reckless statements of ignorant critics to the contrary notwithstanding; and (2) if "the imperfect natural production" employed in the German schools as sign-language deserves the high approval given it by Hill, what must be the value of the perfected ideographic language now used in the manual and combined schools, and among thousands of the deaf in this country, with great profit and the keenest pleasure?

The limits of this paper forbid even the briefest mention of the many reasons in favor of the use of the sign-language in the teaching of the deaf, which might be added to Hill's, from the points of view of the manualist instructor.

It remains only to allude to the very great error, that all deaf children can be successfully taught to speak, and then to add a few words concerning the system of instruction which includes all that is good in all methods.

That all, or nearly all, deaf children can be taught to speak, is not denied; but this is precisely as all normal children can be taught to draw or to sing. All normal children possess the power of producing musical tones, and of delineating the outlines of an object with a pencil. So all deaf children have the organs of speech and the power of producing articulate sounds.

Now, it is well known that very many normal children cannot succeed as artists or vocalists; and few would advise the teaching of art or music to such after it became clear that the talent for these accomplishments was lacking. Success in these lines does not come without effort, and seldom without long and severe training; while success in speaking comes to every normal child by mere association with his fellows, without effort and without special training.

To the totally deaf child success in speaking is attained under conditions not unlike those which attend normal children in their development of the art faculty. When this is absent, or present in a hopelessly weak degree, effort and training will yield only painful and disappointing results; and it is precisely so with certain deaf children who lack a faculty, to which no name has as yet been attached, the existence of which in others insures success in speech, to the joy of their teachers and the pride and delight of admiring friends.

In considering the case of the deaf learning to speak, it must never be forgotten that under no circumstances can they do this as normal children do, by association and without effort, but that in every case speech is an acquisition only possible with great and sustained effort on the part of the pupil, assisted by the skill, patience, and perseverance of able and competent teachers. If one will attempt to master the pronunciation of a foreign tongue, without ever hearing a word of the language spoken by another, he will appreciate, though only in a limited degree, the difficulties attending the acquisition of speech by the totally deaf.

In point of fact, a large proportion of the deaf children educated in oral schools utterly fail of any thing that can be called success in speech; and the value to such, of this imperfect utterance, always painful and often utterly without meaning to listeners, is as nothing when the labor, time, and expense of attaining it are considered.

But, worst of all, the claim that all the deaf can be successfully taught to speak is often flatly refuted by the conduct of those who make it. Cases have come under my own knowledge where admission to prominent oral schools has been denied to certain uneducated deaf children for the reason, given to their parents, that they would be unlikely to succeed in speech, and I have known these very children to be taught to speak in schools conducted under the combined system. Such inconsistency on the part of oral teachers, when known, cannot fail to impair confidence in every thing they may do or say. And this is not the only point in which the attitude of some of the most prominent promoters of oralism is open to condemnation.

Not long since, I received an application for the admission to our college of a young lady whose previous training had been in an oral school of good standing. Her preparation for college was not quite complete, and I suggested that she return to her school and secure the needed preparatory training, which could easily be given her there. Much to my surprise, the principal of this school, on learning of the purpose of the young lady's friends to send her to the college at Washington, not only refused to give any aid in preparing her to enter, but declared he would do every thing in his power to prevent her going to college; and the reason for this was simply because in the college the finger alphabet and signs are made use of, and speech (understood to be fully acquired in the schools) is not taught. Thus this principal of a great school was willing to sacrifice the only chance his "very bright pupil" (as he himself characterized her) had for securing the higher education, because of his hostility to the use of a language which his great master, Hill, regards as "a most efficacious means of assisting even pupils in the higher degrees of school-training."

I have alluded several times to the combined-system schools, in which more than seven-eighths of the deaf children now under instruction in America are to be found. In these schools the principle is recognized and acted on that no one method is suited to the conditions of all the deaf. With many the oral method fails; with some it succeeds; for a large proportion the manual method does not meet all requirements, nor develop all the powers; with a few the aural method is to be preferred to the oral or manual.

Those who sustain the combined system acknowledge the value of all these methods in their proper place, and in the institutions they promote endeavor to give to each method every possible opportunity for success. They advise that every deaf child should have a fair opportunity to learn to speak,— as in the community at large every child should have a chance to learn to draw and to sing,— but they advise with equal earnestness that time should not be wasted in trying to force birds to sing to whom nature has given only the ability to caw or to scream.

Ten years ago there was held at Milan an international convention of instructors of the deaf, at which were presented some notable results of oral teaching in the schools of Milan. The convention was wholly in the hands of partisans of the oral method, and they succeeded in securing the passage of certain resolutions giving a preference for the oral method, which were trumpeted over Europe, and were not without influence even in this country. The effect of this was revolutionary in France and Great Britain, and the cause of oralism made rapid advances during the first half of the decade just closed. In England, however, the progress of oral teaching has received a decided check.

In 1885 the Queen of England appointed a commission, with the Duke of Westminster at its head, who was later succeeded by Lord Egerton of Tatton, with such men upon it as Sir Lyon Playfair, Mr. Mundella, Drs. Armitage and Campbell, and others less known in America, but of equal distinction in their own country, whose duty it was to inquire carefully into the methods of educating the deaf, the blind, and the idiotic, with a view of securing much needed parliamentary aid.

The labors of this commission covered a period of more than four years, during which time the promoters of oralism brought every possible influence to bear to secure the approval of their method and the condemnation of all others. They failed in this. While the commission recommended giving every deaf child an opportunity to learn to speak, they recognized fully that many would not succeed, and that for these other methods of teaching must be employed.

But a more decided support to the combined system comes from England as recently as the last month. Benevolent persons interested in securing the establishment of a new school for the deaf at Preston, for north and east Lancashire, formed a commission of four able men, who examined very carefully the most prominent schools in England of all methods. This commission in their report, made Oct. 8, 1890, recommend most strongly a dual or combined system, declaring that "pure oralism is an idea, not a reality; a useless task to dull pupils; unsatisfactory for a large number of pupils; entirely successful only in exceptional cases and under conditions that are generally impracticable and often impossible."

Such opinions, reached after the careful and impartial examination of intelligent men, interested to arrive only at the truth, ought, it would seem, to be accepted as conclusive.

EDWARD M. GALLAUDET.

WORK AT THE NEW YORK STATE AGRICULTURAL EXPERIMENT STATION.[1]

THE work now in charge of the first assistant is as follows:—

1. *Experiments with Swine.*—So soon as enough skim milk, etc., is available, it is expected to conduct the pig-feeding in connection with the dairy cattle experiments, and comparison of the different breeds of swine will be made. For the present the experiments are confined principally to feeding of various coarse foods that have been used and recommended for swine; e.g., corn-ensilage, sorghum, prickly comfrey, beets, clover and clover ensilage, etc.

2. *Experiments with Poultry.*—Feeding-experiments with rations more and less nitrogenous have been made with young and mature laying stock; and these experiments extend always throughout the whole laying season, some of both large and small breeds being used. Feeding-experiments are being made, and have been, with capons and cockerels. Experiments have been made with home-made and inexpensive incubators and brooders, and it is expected to continue them. Preparations are now nearly completed for breeding-experiments with tested individuals of several breeds. Considerable chemical work has been done, and experiments are now (although temporarily interrupted) in progress to answer the question definitely whether inorganic material, as stone, oyster-shells, etc , can supply lime for the egg shell. Experiments to ascertain the cost of production and value of product, in rearing chicks of different market breeds from the shell, under different foods and methods of hatching and brooding, are expected to be undertaken.

3. *Soil Experiments.*—The laboratory work on soils has been for the present discontinued, but only from pressure of more immediately necessary work. In the field, application of several cheap chemicals has been made; viz., sulphate of soda, sulphate of lime, sulphate of magnesia, sulphate of iron, carbonate of lime, common salt. The effect on the crop and soil is studied. These have only been applied one season, but it is intended to repeat the application several years on the same strips of soil under different crops.

4. *The Investigation, Selection, and Acclimatizing of Sorghums.*—Of the two or three hundred samples of seed, representing a hundred and fifty or more varieties that have been grown during the last three seasons, less than a dozen have been selected for

[1] From the Geneva Gazette, Nov. 14, 1890.

future use as of value in this State. Among these, however, are some very promising varieties. This necessitates, besides work in the field, much chemical work, analyses of juices, etc.

5. It is also proposed to enter upon another line of work with our pasture and meadow grasses,—the selection, preservation, and propagation in absolute purity, by sod-culture and seed, of the most vigorous and hardy strains and individuals of the most valuable varieties. It is hoped to establish the better types as standard by co-operation with some other stations, and to supplant the degenerate varieties so largely used.

Maps, charts, plans, and drawings for purposes of illustration of station work, have also been made.

In the chemical department the following work is in hand: 1. Analysis of milk of registered cows undergoing experiment (this work involves at present the complete analyses, each week, of from ten to fourteen samples of milk, and the extent of the work will increase until the whole herd is in milk); 2. Analysis of skim milk, buttermilk, and butter, in connection with the foregoing, requiring at present from fifteen to twenty-one analyses each week; 3. An extended investigation into various methods of creaming, requiring at present seven analyses each week, but soon the work will be increased threefold; 4. Analyses of all the feeding-stuffs connected with various experiments being carried on at the station; 5. Analysis of fertilizers in accordance with the recent law establishing a fertilizer-control at the station; 6. An investigation into the influence of acidity of cream upon the quantity and quality of butter produced; 7. Experiments relating to a more accurate method for the determination of fat in feeding-stuffs; 8. Experiments relating to a simple method for the determination of nitrogen in nitrates; 9. Analysis of various things sent to the laboratory from different parts of the State.

The work being carried on in the horticultural department is a continuation of that of last season, with the addition of such other lines as have been thought best. The leading features are (1) tests of the novelties in vegetables as to their desirability and commercial value; (2) tests of vegetable seeds, especially cauliflower and cabbage, to ascertain the value of American-grown seed as compared with imported seed; (3) the acclimatization of vegetables not native to this climate, notably the sweet-potato, with which very successful results have been obtained; (4) the forcing, under glass, of such vegetables as seem best adapted for that purpose; (5) tests of varieties of small-fruits, which consist in the study of the varieties as to their commercial value and adaptability to the climate of this State: (6) also, so far as facilities offer, work in cross-fertilization, tending to the improvement of varieties and the special study of pollen influence. This line of work is of very great value, and a large part of the greenhouse has been set apart for the continuation of it through this coming winter, as there are, from the results of last winter's crossing, over one thousand seedlings to be tested; and the data, if as valuable as expected, should be before the public as soon as possible.

The above is in connection with the daily routine of note taking, and records made of the planting, germination, growth, habit, blossoming and fruiting season, of all plants in this department, a large number of which notes are merely for reference, and are only inserted in our record-books, making no showing that would lead the public to know what a vast amount of constant painstaking work is necessary to keep records that become of greater value year by year.

In the pomological department the testing of the large fruits and of the varieties of grapes is being carried on as heretofore, and a study made of their habits of growth, vigor, susceptibility to disease, hardiness, and adaptability to this climate; also of the diseases affecting the different fruits, especially the grape. Experiments are being continued with fungicides and insecticides, with the object of obtaining simple and effective remedies for the holding in check or entirely ridding our orchards and vineyards both of fungi and the insect pests that are rendering such a large proportion of our fruit worthless. A more extended line of experiments is being planned for the coming year, intended to embrace a larger field; and some of them will be carried outside the station limits through the courtesy of nurserymen and fruit-growers, a number of whom have offered to place the necessary land and stock at the disposal of the station. It is intended that a portion of this work shall be devoted to experiments with fertilizers. In connection with this, an object-lesson in the chemical composition of the ash of four leading fruits (apple, pear, plum, and cherry) and of two of the woods (grape and apple) has been prepared, showing the amounts of the different fertilizing and mineral elements removed from the soil by the growth of 150 pounds of each of the fruits named, also by 100 pounds of the wood of the grape and apple. It is intended for use at the fairs, farmers' clubs, and meetings of fruit-growers, and for use at the station.

As a portion of the general farm-work has been included in this department, a considerable amount of routine work has necessarily to be performed. Experiments have also been started with cereals and grasses, to test varieties and methods of seeding. Others are planned with fertilizers, ensilage, crops for soiling, and methods to obtain the best and most economical results.

In addition to the above regular and systematic work of investigation going on at the station, there have been published during the past year, in addition to an annual report of several hundred pages, seven bulletins with an aggregate of 173 pages, 45,000 copies of which, in all, have been distributed among the farmers of the State; while the correspondence has steadily and rapidly increased from a total of less than 500 letters in 1887, to over 2,000 during the past year, many of these letters of inquiry necessitating study and investigation.

NOTES AND NEWS.

There are few injurious insects for which more remedies and preventives have been recommended than for the striped cucumber beetle,— the everywhere abundant yellow "bug" with black stripes along its back, which attacks squashes, cucumbers, melons, and in fact nearly all cucurbitaceous plants. A large portion of these remedies are doubtless worthless, if indeed not positively injurious. In order to get a more definite knowledge of the preventive or remedial value of these various substances, the Ohio Experiment Station began last season a series of experiments in which it is designed to give each a practical field test, and, if possible, to arrive at some reliable conclusions for the guidance of the interested public. The results of last year's work showed that many of the so-called remedies are worthless, some even being worse than the disease. The experiments were continued this year on an extensive scale. A field of two acres was put in good condition by the use of plough and harrow, and was planted to squashes, melons, and cucumbers according to the ordinary plan of growing these vegetables. The seeds came up early in June, and the first striped beetles appeared soon after. They then came in great numbers, and destroyed a large number of plants before they could be treated. Two general methods of treatment were employed: (1) coating the plants with poisonous substances, and (2) fencing out the insects by mechanical barriers. The best success was attained in the first class of remedies by the use of tobacco-powder,— the refuse packing of the cigar-factories. A number of barrels of this substance were obtained at a cigar-factory. A shovelful of the powder was thrown on each hill. The first application was made to eighty hills, June 12. Rains coming soon after, it was repeated June 14, 16, and 17. The results were excellent. The beetles seemed to dislike working in the tobacco, and the plants on all the hills so treated came through in good condition. Aside from its value as an insecticide, the tobacco acts both as a mulch and fertilizer. Chemical analysis shows that its value as a fertilizer is twenty five dollars per ton. In many Eastern cities it is being utilized, but in Columbus and other Ohio cities many of the factories are glad to give this refuse to any one who will take it away. Various methods of mechanical exclusion of the beetles were again tried with good success. This may be done by simply placing over the plants a piece of thin plant-cloth or cheese-cloth about two feet square, and fastening the edges down by loose earth. It is better, however, to hold the centre of the cloth up by means of a half barrel-hoop, or wires bent in the form of a croquet arch. It is frequently stated that

these beetles will not attack plants if simple frames, consisting of four pieces of boards nailed together, without a top of any kind, are placed over the hills. This method was tried with a number of frames ranging from four to ten inches in height. As anticipated, the method was entirely unsuccessful, every plant of the hills so covered being destroyed by the beetles.

— The next meeting of the American branch of the Society for Psychical Research will be held at the rooms of the Boston Society of Natural History, corner of Berkeley and Boylston Streets, on Tuesday, Dec. 2, at 8 P.M. The secretary will give an account of some cases recently received or investigated, and make a report of some sittings with Mrs. Piper in England, by Professor Oliver Lodge, F.R.S. No admittance except by ticket, which may be obtained by members or associates on application to the secretary, Richard Hodgson, 5 Boylston Place, Boston, Mass.

— The new building for the Philadelphia Polyclinic and College for Graduates in Medicine will be ready Jan. 1, 1891, and will provide accommodations for the Polyclinic, or college departments, the Polyclinic Hospital, the Ladies' Aid Society of the Polyclinic Hospital, the Polyclinic Medical Society, and the Polyclinic Medical Library. Since 1882 post-graduate medical schools have been established in New York, Chicago, Baltimore, Cincinnati, St. Louis, New Orleans, and Boston. With the single exception of the Johns Hopkins University, all occupy modified old buildings, while this new building is especially adapted from a personal knowledge of the requirements acquired in the old, long-established, and largely endowed institutions of Europe, and arranged by the architects, Messrs. Baker & Dallett. The special features of this new structure are, first, that it has been built to meet the requirements of combining in one institution all of the peculiar advantages to be derived from those hospitals which are devoted to the treatment of a single class of diseases, known as special hospitals; second, the building is arranged to facilitate carrying out the essential character of practical teaching, in which pupils who are practitioners of medicine may be brought in classes, which are always limited in number, into direct contact with the patients. The building is constructed of brick and terra-cotta. The system of heating is by indirect radiation. Incased steam-coils are placed in the cellar, and there heat the pure air brought in by conduits. Other conduits conduct the heated air to the rooms and hallways. Ventilation is accomplished by substratum suction. The exit registers are placed in the walls near the floors, and in proper relation to the position of the hot-air registers. The impure air is carried down to the air-tight ducts under the cellar floor, and passes out above the roof through the high brick stack. In the centre of this stack is a cast-iron pipe, through which passes the gaseous products of combustion from the engine-room. The constant heat in this iron pipe maintains an upward current of air around it inside of the brick stack. This system is arranged to permit the addition, at trifling expense, of an electrical or steam blower, should this be found necessary. All the corners in the building are rounded, to prevent the accumulation of dust and to facilitate thorough cleansing. The elevator shaft, iron stairs, and all toilet-rooms are placed in a practically detached building, which greatly enhances the sanitary condition. City gas has been introduced throughout, but it is contemplated introducing an electric-light plant as soon as funds can be obtained. Varnished natural wood is used throughout the interior, paint being used on the exterior only. The future success of this institution, which is the only one of its kind in Pennsylvania, depends entirely upon the financial support given to it by generous-hearted citizens. It is a matter of experience that charitable and educational institutions are successful in proportion to their endowments. None are self-supporting. The higher medical education of the physician affects the entire community, each and all being subject to illness and accident, each and all desiring above all things a speedy recovery of health. This is materially aided by the Philadelphia Polyclinic, which is the only post-graduate medical college and hospital in Pennsylvania. The endowment of scholarships will permit the awarding of the unique facilities of The Polyclinic to deserving physicians of limited means, as, for example, medical missionaries, or the extending similiar privileges to the medical staff of the army and navy. The endowment of departments will provide the elaborate and often expensive apparatus required by all. The endowment of free beds increases the charitable work.

— The proceedings of the twenty-third annual meeting of the Kansas Academy of Science, held at Lawrence, Nov. 5, 6, and 7, were as follows: Wednesday at 5 P.M. business meeting at the Eldridge House, at 8 P.M. public lecture in Snow Hall by the retiring president, Professor G. H. Failyer; Thursday at 9 A.M. and 3 P.M. meetings for the reading of papers in Snow Hall, at 8 P.M. a reception to visiting members, tendered by the University Science Club; Friday at 9 A.M. and 3 P.M. meetings for the reading of papers, at 8 P.M. an exhibition of lantern and microscopic slides in the University Chapel. The following papers were read, some being by title only: "Observations on the Nutation of Sunflowers," and "Germination of Indian-Corn after Immersion in Water of Different Temperatures," by W. A. Kellerman; "Periodicity in Plants," and "Additions to the Flora of Kansas," by B. B. Smyth; "Plants of the Colorado Boundary," and "Notes on Southern Kansas Plants," by M. A. Carlton; "Equation of the Mean Monthly 21-Year Temperature Curve of Lawrence, Kan.," by E. C. Murphy; "Annual Precipitation of Rain and Snow at Manhattan, Kan., for the Past Thirty-two Years (Chart)," and "Mean Hourly Velocity of Wind at Manhattan, Kan. (Chart)," by C. M. Breese; "An Electrical Hygrometer," by L. I. Blake; "On the Relative Sweetness of the Different Series of Alcohols," by E. E. Slosson; "The Selective Power of the Sense of Taste," by E. H. S. Bailey; "The Sugars of Watermelons," by J. T. Willard; "Notes on Sugar Beets," by G. H. Failyer and J. T. Willard; "Some Notes on Kansas Meteorites," by F. H. Snow; "Notes on Kansas Salt Marshes," by Robert Hay; "Evidences of Prehistoric Man in Labette County, Kan.," by W. S. Hill; "Notes on Some Fossils of Lincoln County, Kan.," by D. S. Kelley; "A Comparison of Preservative Fluids for Museum Use," by V. L. Kellogg and E. E. Slosson; "Notes on Summer Birds of Estes Park, Colorado," by V. L. Kellogg; "On the Skull of Discosaurus," by S. W. Williston; "The Civilization of the Mound-Builders," by H. C. Fellow; "Evolution of the Human Face," by A. H. Thompson; "Equal and Unequal Taxation," by J. H. Carruth; "On the Valuation of Mustard from an Estimation of its Sulphuretted Oil," by L. E. Sayre; "Notes on Kansas Minerals," by G. H. Failyer; "Analysis of 'Feather Alum' from Colorado," by E. H. S. Bailey; "On the Most Economic Process for the Manufacture of Iodoform," by S. R. Boyce; "A New Siphoning Extraction Apparatus," by G. H. Failyer and J. T. Willard; "Radiation of Heat from Foliage," by A. G. Mayer; "A New Fire-Screen," and "Notes on the Thermal Resistance of Fire-Screens," by T. H. Dinsmore; "First Addition to the List of Kansas Peronos Peraceæ," by W. T. Swingle; "Preliminary Notice of Some Kansas Rolling Plants," by W. T. Swingle and D. G. Fairchild; "Harmonic Forms," by B. B. Smyth; "On Certain Generic Characters of Tachinida," by S. W. Williston; "The Flora of Cherokee County, Tex.," by Mrs. A. L. Slosson; "Evolution in Leaves," by Mrs. W. A. Kellerman; "Notes on the Grasses found in the Vicinity of Manhattan," by W. A Kellerman and Bessie Little; "Note of the Precision of the Solar Attachment," by F. O. Marvin; "Preparation for Scientific Work," by T. H. Dinsmore; "Structure of the Kansas Chalk," by S. W. Williston; "Notes on Sorghum Smuts," by W. A. Kellerman and W. T. Swingle; "Notes on the Distribution and Ravages of the Hackberry Knot," by W. A Kellerman; "Methods of Collecting, Cleaning, and Mounting Diatoms," by Gertrude Crotty; "The Union of Cuscuta Glomerata with its Host," by W. C. Stevens; "On the Best Gun for Collecting Naturalist," by J. J. Graham; "Note on the Occurrence of Mammoth Remains in Franklin County, Kan.," by O. C. Charlton; "On the Action of the Pasteur Filter on a Solution containing Bacteria," by L. E. Sayre and V. L. Kellogg; "Differentials of Higher Orders than the First," by E. Miller; "Certain Curves and Surfaces derived from Surfaces of the Second Degree," by H. B Newson; "Camp of Prehistoric People found near Wichita, Kan.," by J. R. Mead; "Experiments in 1890 for the Artificial Dissemination of the Chinch-Bug Disease," by F. H. Snow; "Note on an Insect found in Flaxseed," by D. S. Kelley.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

Vol. XVI. NEW YORK, November 28, 1890. No. 408.

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LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Right-handedness and Effort.

Professor James replies in *Science* for Nov. 14 to my letter in the issue of Oct. 31, taking exception to my interpretation of my baby's use of her right hand only for strong efforts. Without summarizing the points at issue, I may indicate where it seems to me his explanation lacks force.

In the first place, I agree with him in all that he says about a "natural prepotency in the (brain) paths to discharge into the right arm." This is undoubtedly the explanation of right-handedness, as my observations would indicate as far as they go. I also agree with him in casting out the view that brings in conscious distinct memories and choices. They are a later development. There is nothing in my letter to indicate such a view. On the contrary, I accept the "semi-reflex" theory of the possibility of the use of either hand. But quite apart from these facts of the nervous basis, the question arises: What is the least difference in consciousness required to explain the preferential use of the right hand when effort is involved?

Now, Professor James kindly says that my observations "show how strong stimuli may produce more definitely localized re-actions than weaker ones. The baby grasped at bright colors with the right hand almost exclusively." So far clear enough. But whenever the same stimulus, say a piece of common newspaper, was used in two experiments, at ten and at fourteen inches distance respectively, the same "more definitely localized re-action" took place in the second case; but in this latter case the stimulus which produced this "more definitely localized re-action" was fainter, being farther away, and the other conditions being the same in the two experiments. The child always used the right hand for long distances, even when the objective amount of stimulus remained the same. The least inference, I think, is that the intensity of the stimulus is not, at any rate, the exclusive cause of the more definite re-action. Greater intensity might account for the use of the right hand in some cases, but we certainly cannot hold at the same time that lesser intensity accounts for it in others.

The new element must represent the influence of former experience. I see no way to avoid this alternative. This is what I meant by "memories," merely some kind of a conscious modification which alters future re-actions. A purely physical modification would not suffice, for it would have its full force also in cases which involved no effort. Now, we may hold that such "memories" are exclusively of afferent nerve processes, or that they involve also a conscious modification due to efferent nerve processes. If the former, we may attribute them to the greater "promptitude, security, and ease" of right-hand movements, as Professor James suggests, or to former movements of the eyes, involved in the visual estimation of distance (which I am astonished he does not suggest) The first alternative, which Professor James asks my ground for rejecting, is inadequate for the following reasons. If such memories of afferent processes be of movements with effort, they are already right-handed, and the question is only thrown farther back; but, if they be of effortless movements, then their motor influence would be perfectly indifferent, as I said in my former letter. My experiments show this. If there had been differences in "promptitude," etc., the child certainly would have shown preference for the right hand in effortless movements during the latter six months of the first year. But, on the contrary, it was only when making violent effort that there was any preference at all. Even after she developed such preference in cases of effort, the use of her hands when no effort was required continued to be quite indifferent. Does not this indicate that the traces left by former afferent processes of the same sense are not sufficient?

Moreover, in the absence of all feeling of the efferent current, what could sensations of "promptitude," etc., be but the consciousness of better adaptation and co-ordination of movements? But at this stage of life all the child's movements are so ataxic, that there seems to be no practical difference between the two hands in regard to the lack of the tactile delicacy in which pathological cases show motor ataxy to consist.

If we seek for the needed "memory" among the sensations of eye-movements in the case where the stimulus is weaker (more distant), it is possible that we may find an afferent element which brings up the intensity of the hand-memories to the necessary pitch. There may be a connection between the centres for feelings of eye-movement and feelings of hand movement, so that their united "dynamogenic" influence is the same as the high intensity of the color stimulus. But, while freely admitting such a possibility, it only pushes the question farther back again; for how do we know that these eye-memories do not involve consciousness of the efferent process which innervates the eye-centre? And, besides this, there is another element in the hypothesis that afferent elements from other senses may furnish the "kinæsthetic co-efficient" for a given voluntary movement; namely, that such activities of the other senses invoked took place along with movements of the attention, which might, and probably do, contribute an efferent element to consciousness. This possibility I have never seen anywhere recognized.

But in this case my experiments show conclusively that eye-movement memories did not re-enforce the intensity of the arm-movement memories; for, when the distance was more than fourteen

inches, the re-action was inhibited altogether. The distance of the stimulus as apprehended by the eye, therefore, instead of giving the increased motor excitement which we require, rather diminishes it, and makes the need for some other explanation all the more imperative.

It appears, therefore, that the element needed in consciousness to explain the facts cited in my former letter is some kind of a difference in sensation corresponding to the outgo of the nervous current into the right arm, be it as vague, subconscious, and unworthy of the name of "memory" as you please; that is, I still think that my experiments support the traditional doctrine. On any other theory, right-handedness would have been developed independently of effort. J. MARK BALDWIN.

Toronto, Ont., Nov. 18.

Mount St. Elias.

IT is with great reluctance that I return to the subject again, but I beg to be permitted two statements in regard to the matter recently a subject of discussion between myself and Professor Heilprin in your columns.

In the first place, I did not "unfavorably criticise" Professor Heilprin's "work in Mexico." I merely pointed out that he assigned a weight to the observations which his equipment afforded which that class of instrument (viz., a pocket aneroid) is not entitled to, and that the result of such observations (as to the accuracy or inaccuracy of which I raised no question) is not determinative within the limits he assumed.

In the second place, discussion, in order to be profitable, especially in such matters as measurements and methods, must be just and accurate as well in the representation of an adversary's position as in the statement of one's own. In cases where the mutual recognition of this obvious truism is impracticable for any reason, I feel that it is better to cease the discussion, even though it leaves me apparently worsted in the argument. As a matter of fact, Professor Heilprin's understanding of the work printed in the St. Elias report ("Coast Survey Report for 1875") is hopelessly inaccurate and confused; and to that report, therefore, I refer those who are competent to judge of such matters, and may care to possess themselves of the facts in the case.

WM. H. DALL.

Smithsonian Institution, Nov. 22.

Annular Phase of Venus.

AN opportunity of observing an unusual, if not remarkable, phenomenon will soon occur; and I wish to call the attention of astronomers to it, as another opportunity will not present itself until after the lapse of eight years. This phenomenon may be conveniently called the annular phase of the planet Venus, though it be produced not by reflected light only, as in the ordinary phases of the moon, but partly also by the refracted light of the sun, which has passed through the planet's atmosphere This phase I unexpectedly witnessed twenty-four years ago under the following circumstances: —

I desired to observe the prolongations of the cusps of the crescent of light, mentioned by several writers, and which I afterwards found had been observed by Mädler in May, 1849, and used by him to obtain the amount of refraction in the atmosphere of Venus; but I had not then read his paper on the subject, and was unacquainted with his formulæ.

It was well known, that, if Venus and the earth at any time occupied certain relative positions in their orbits, they would return very nearly to the same points, after an interval of eight years less two and a half days. It was also well known that Venus would transit the northern part of the sun during the forenoon of the 9th of December, 1874 (civil day at Greenwich), and would transit the southern part eight years less two and a half days later, or during the afternoon hours of the 6th of December, 1882. It was therefore evident that it would pass north of the sun, and very near it, eight years less two and a half days before the first of these transits, and would approach nearest to the sun about 2 P.M. (Greenwich time) on the 11th of December, 1866, least distance of centres being about 38′ of arc. I therefore prepared to observe the planet on the forenoon of that day.

My observations were made in the open air, on the grounds of the College of Charleston, with a telescope presented to the college many years ago by William Lucas, Esq. This telescope is a refractor by Troughton & Simms, 5 feet focal length, 3⅝ inches aperture, eye pieces used magnifying 70 and 120 diameters. I so placed my telescope that the apex of the north gable of the library building, 23 yards distant, screened its object-glass from the rays of the sun; and the planet was easily found and distinctly seen above the roof of the library, least distance of nearest limbs about 22′. To my surprise, even astonishment, I saw not merely two cusps prolonged, but the whole circumference completely enlightened, the disk of the planet surrounded by a ring of light, broadest on the side nearest to the sun, narrower but quite bright on the opposite side. To have additional testimony to this fact, I immediately called to witness it Messrs. E. T. Frost and W. St. J. Jervey, two students in my astronomical class. They at once recognized the illuminated circumference, and said that it resembled in form the annular eclipse of the sun in October, 1865, which they had seen in this city in the preceding year. As said above, I was at this time unacquainted with Mädler's observations and formulæ, and, not having seen any intimation of the possibility of such a phenomenon, it took me wholly by surprise. I continued to watch the planet from 9 to 11 A.M, when the library building ceased to be available as a screen. This interval includes the instant of nearest approach of centres, which occurred about 9.30 A.M, Charleston mean time.

As far as I can learn, the only other persons who saw the phenomenon at that time were Professor C. S. Lyman of New Haven, Conn., and a few of his friends. In his equatorial of 9-inch aperture he saw the annulus or ring on the 10th completely formed; but the line of light on the side farthest from the sun was slender, faint, and only seen by glimpses. He saw it again on the 12th, but did not attempt to observe it on the 11th, the day of conjunction, when I saw it as a brilliant ring of light. He doubtless would have succeeded perfectly if he had abandoned the equatorial, which could not be screened, and used a more portable telescope, with some building as a screen.

In 1874 I watched the planet at intervals from the 30th of November to the 12th of December, the transit taking place on the night of the 8th and 9th, Charleston civil time. On the 2d of December I saw for the first time during this interval the distinct prolongation of the cusps, and watched their increase from day to day until the 8th, making eye-estimates of the number of degrees in the enlightened portion of the circumference, as I had not efficient means for making micrometer observations. On the 8th and the 9th I fully expected again to see the annular phase, but failed entirely to find the planet on both days There were no clouds, at least not sufficient to entirely prevent observations, but there was a dense haze, and the region near the sun was strongly illuminated.

At this transit Mr. Lyman was more successful than myself, making good micrometer observations of the enlightened portion of the circumference, and seeing distinctly the illuminated ring on the 8th, the day before the transit. On the 9th he was, like myself, wholly unsuccessful in finding the planet, but on the following days continued his micrometer measures. The results of these observations he published in the *American Journal of Science and Arts* for January, 1875, with the amount of refraction in the atmosphere of Venus deduced from his observations, and also Mädler's formulæ by which it was deduced.

In December, 1882, the weather was so unfavorable on the day of the transit, the 6th, and for several days preceding and following, that I made no attempt to observe it before and after conjunction, and no accounts of the observations of others have reached me; but the scientific periodicals to which I have access are so few, that it would be unwarrantable to say that none have been made.

The next opportunity for observation will occur eight years less two and a half days after the last transit, that is, on the 3d of December next, when the least distance of centres will be about 35′, at about 5.30 P.M., Greenwich civil time. As Venus will

pass south of the sun, it will not be so easy to use buildings as screens in the northern hemisphere, and special means must be devised. The luminous ring will be as bright and conspicuous as in 1866, and the first appearance of the prolongation of the cusps may be looked for about the 24th of November.

It is now evident that similar opportunities will happen on the 1st of December, 1898, when least distance of centres will be about 1°, and about the 28th of November, 1906, when least distance of centres will be about 1½°, the planet in both cases south of the sun. In each case the least distance of centres will be less than the limit within which the formation of the luminous ring is possible, but the duration of the ring will be successively less as the least distance between centres becomes greater. No other opportunities will present themselves until near the end of the next century, when they will occur in June.

Similar opportunities must have occurred in years preceding 1866; that is, on the 14th of December, 1858, and also on the 16th of December, 1850; but it does not appear that either was used. This last date is only nineteen months after Mädler's observations in May, 1849; and, if any one properly situated as to time had endeavored to repeat Mädler's observation on the day of conjunction, he would almost certainly have seen the luminous ring.

LEWIS R. GIBBES.

Charleston, S.C., Nov. 13.

A Problem in Physics.

AN experiment was tried by Joule nearly fifty years ago which has attained a world-wide reputation, and which has crept into nearly every text-book of physics. The commonly accepted interpretation of it, however, would seem not entirely satisfactory. I will quote from Tait's description of the experiment.

"Joule took a strong vessel containing compressed air, and connected it with another equal vessel which was exhausted of air. These two vessels were immersed each in a tank of water. After the water in the tanks had been stirred carefully, . . . a stop-cock in the pipe connecting the two vessels was suddenly opened. The compressed air immediately began to rush violently into the empty vessel, and continued to do so till the pressure became the same in both; and the result was, as every one might have expected, that the vessel from which the air had been forcibly extruded fell in temperature in consequence of that operation. It had expended some of its energy in forcing the air into the other vessel; but that air, being violently forced into the other vessel, impinged against the sides of that vessel, and thus the energy with which it was forced in through the tap was again converted into heat. On stirring the water round these vessels, after the transmission of air had been completed and the stop-cock closed, Joule found that the number of units of heat lost by the vessel and the water on the one side was almost precisely equal to the quantity of heat which had been gained on the other side." Tyndall gives the following (let B represent the vessel in which the air was compressed to 22 atmospheres, and A the vessel which was exhausted): —

"Now, the air, in driving its own particles out of B, performs work, . . . and the air which remains in B must be chilled. The particles of air enter A with a certain velocity, to generate which the heat of the air in B has been sacrificed; but they immediately strike against the interior surface of A, their motion of translation is annihilated, and the exact quantity of heat lost by B appears in A. The contents of A and B mixed together give air of the original temperature. There is no work performed, and there is no loss of heat." Tyndall gives an illustration of a cylinder having a piston in the centre, and the space above the piston a vacuum. Suppose the air below the piston is heated up from 0° to 273° C. "If the pressure were removed, the air would expand, and fill the cylinder. The lower portion of the column would thereby be chilled, but the upper portion would be heated; and, mixing both portions together, we should have the whole column at a temperature of 273°. In this case we raise the temperature of the gas from 0° to 273°, and afterward allow it to double its volume. The temperatures of the gas at the beginning and at the end are the same as when the gas expands against a constant pressure, or lifts a constant weight; but the absolute quantity of heat in the latter case is 1,421 times that employed in the former, because, in the one case, the gas performs mechanical work, and in the other not."

The following quotation is from Balfour Stewart, and bears upon this question: —

"The prevalent idea is, that when air expands it becomes colder, and that when condensed it becomes hotter; but Joule, by experiment, has shown that no appreciable change of temperature occurs when air is allowed to expand in such a manner as not to develop mechanical power. It follows as an inference, that, when air is compressed, the rise of temperature is scarcely at all due to the mere diminution of the distance between the particles, but almost entirely to the mechanical effect which must be spent on the air before this condensation can be produced."

A final quotation is taken from Ganot's "Physics:"—

"A strong metal box is taken, provided with a stop-cock, on which can be screwed a small condensing-pump. Having compressed the air by its means as it becomes heated by this process, the box is allowed to stand for some time, until it has acquired the temperature of the surrounding medium. On opening the stop cock, the air rushes out; it is expelled by the expansive force of the internal air: in short, the air drives itself out Work is therefore performed by the air, and there should be a disappearance of heat; and, if the jet of air be allowed to strike against a thermopile, the galvanometer is deflected, and the direction of its deflection indicates a cooling. . . . Joule placed in a calorimeter two equal copper reservoirs, which could be connected by a tube. One of these contained air at 22 atmospheres; the other was exhausted. When they were connected, they came into equilibrium under a pressure of 11 atmospheres; but, as the gas in expanding had done no work, there was no alteration in temperature."

I have given these quotations rather freely from standard authors, in order to present the problem as clearly as possible. In order to arrive at just the action taking place in this experiment, it seems to me a phenomenon first described by Faraday in 1827 should be mentioned. Gas compressed to 30 atmospheres was allowed to suddenly enter a cylinder 30 feet long, in which the gas was at atmospheric pressure presumably. It was found, that, where the gas rushed in, the cylinder was much cooled, while at the other end it was heated. It would seem that in this case the heating was not produced by the particles of gas impinging upon the end of the cylinder. If a piston were placed in front of the expanding gas, the whole of the gas on the other side of the piston would be compressed and heated. If, now, instead of a piston, we open a stop-cock at the end of the cylinder, the gas would stream in and compress that already there, and heat it; but the gas, expanding violently as it enters, would be much cooled, and this would more than counteract the heating where it enters. Thus the farther end would show a heating, while the end at the orifice would show a cooling as observed. Have we not precisely analogous phenomena in Joule's experiment? For a very small fraction of a second (perhaps .0001) after the stop-cock was opened, there would be a partial vacuum in A, into which the air streams; but after that the particles would not impinge upon the sides of A, but would have their velocity diminished and finally overcome by striking other particles. In imparting this velocity, the particles in B would be slightly chilled. The air, in streaming out of B, would be cooled by expansion after an instant, and would serve to cool the end of A near the orifice, as we have just seen; also the chilled particles in B would stream into A, and thus cool it still more. Whatever may be the action in these vessels, it is certain that the final heating in A, and cooling in B, would be exceedingly slight as shown by Joule's experiment, though it does not seem that the popular explanation is entirely correct.

It seems to me this question of the action of air in Joule's two vessels is an intensely interesting one. The conclusion that the chilling of the air in the vessel due to the work of imparting a velocity to its particles is very slight, corroborates in a marked manner the experiments tried by the present writer, in which he found a cooling of four degrees, while the dynamical cooling should have been ten times greater. The quotation from Ganot shows precisely an analogous case.

H. A. HAZEN.

Washington, Nov. 17.

Children as Teachers.

FROM olden times it has been thought that adults should be the teachers, and children simply learners; but in this nineteenth century of civilization the greatest find that they can learn from the little ones. The best educators are those who have learned most from little children, and the most successful primary teachers are those who can see and feel things as children see and feel them. Authors of literature and text-books for children must now know child-nature, or fail. Scientific philologists are beginning to recognize the fact that children just learning to talk can in a few months teach them more about how languages are formed than can be learned by years of study of dead and living languages. Even the philosopher and psychologist are turning to the child for the solution of some of the problems that have so long baffled them, and the practical moralist turns from theories to learn of children how moral ideas are formed and moral action called forth.

The development of the race is epitomized in the development of the child, and the observer may read it in the unfolding psychical activity of the innocent child with more pleasure and profit than in the learned histories of civilization.

Tiederman, Darwin, Taine, Alcott, Romanes, and other learned men have studied their own children scientifically, and taken notes on their development, while Perez Kussmaul and others have made observations on a number of children. Humphreys, Holden, and Noble have collected and examined the vocabularies of several children two years old, in order to discover the general laws of speech. Emily Talbot has collected observations of mothers on young babes. The most thorough and accurate study has, however, been made by Preyer, who carefully observed and experimented upon his boy during the first three years of his life, noting down each day every thing calculated to throw light upon the capacity of children and the order of the development of their powers. Much light has been thrown on many subjects by these investigations, but a sufficient number of carefully verified facts has not yet been collected to enable us with certainty to distinguish characteristics common to all from individual peculiarities. It has been made evident that not only must there be persevering exactness in observing and recording the facts, but that many of them can be accurately observed and correctly interpreted only by one versed in physiology and psychology.

Considerable interest has been aroused and many plans proposed designed to increase scientific knowledge on the subject, to bring parents into new and pleasanter relations with each other, and to preserve records of interest and value to the family. Probably no more acceptable or more valuable present could be given a child who has just attained his majority than a little book containing a record of his life from babyhood. The data contained in such a record would make it possible for him to obey the maxim "Know thyself," and to guide his life by that knowledge, while the little incidents of childish life that give so much pleasure when remembered and related by the parents would be preserved and enjoyed by himself and his descendants. Parents who have engaged in such observations have not only learned to understand their children better, and been drawn into closer relations with them, but have also found the task most interesting and delightful.

It will probably be years before the observations of many scientists on children can be collected, but in the mean time a father, mother, or older sister of ordinary intelligence can, by exercising patience and care, observe and record certain facts of child-development that will be as important and reliable as those furnished by the most learned scientist. These observations, also, are those made at the most interesting age of the child's life,— the period of the development of speech. With a little care, the mother can easily record the development of language in her cunning little prattler,— an evolution as remarkable and full of interest as that traced by the philologist in the languages of the various races in different ages, and throwing as much light on the origin of speech in man and the laws of its development. The mother who will make out a list of all the words now used by her little language-learner, and then carefully note down new words as they are learned, may contribute facts leading to results as important as have been discovered by scientists after years of investigation.

There are two principal things to notice in such a study: (1) the development of the power of articulating, and (2) the development of the intellect: hence it is necessary to keep two lists of words,—one containing all words articulated by the child, with indications as to how they are pronounced; and the other, all words used understandingly, those used only in direct imitation, only at sight of pictures in a book, or only from memory, as in nursery rhymes, being omitted from this list. The first list would indicate the common difficulties encountered in learning to articulate, and an examination of a sufficient number would make it possible to determine whether there really are any general laws of mispronunciation such as have been proposed. The second list would indicate the intellectnal progress of the child as it learns new words, and learns to use old ones with increasing accuracy, and to put them together into phrases and sentences. Words that are invented by the child, and those used in a sense different from the ordinary meaning, are especially interesting, and throw considerable light on the subject of how children classify and generalize. A child who saw and heard a duck on the water called it "quack;" and, this word being thus associated with the bird and with the liquid upon which it rested, he thereafter called all birds and all liquids "quack," and later, seeing the eagle on a coin, he called that and other coins "quack." The observing mother will note many similar peculiar yet natural uses of words by her little one who is getting acquainted with this complex world of ours and learning the strange language of its inhabitants.

After the child's present vocabulary has been obtained as accurately as possible, its further progress can easily be recorded by noting down new words as they are heard (in alphabetical order). It will be found convenient to use separate sheets for each week, or perhaps for each month in the case of the articulating vocabulary. No confusion will then result, and on the back of the sheets may be given the peculiar meanings attached to words, the earlier attempts at putting words together, the later sentences of interest, especially those showing the characteristic grammatical errors, and other items of interest. Such lists of words, kept from the time a child begins to talk until he is three years of age, could not fail to give interesting and more or less important results; and a comparison of a number of vocabularies of children under three years of age, such as could be obtained by a few months of observation, would have a similar value. How much do the vocabularies of children in cities differ from those in the country or in villages? What is the effect on the vocabulary of associating with other children of nearly the same age? What influence does ease or difficulty of pronunciation have upon the adoption of words into the vocabulary, and what is the effect of special teaching by parents? These are a few of the many interesting questions that might be answered from such vocabularies, accompanied by the necessary information. Notwithstanding these various influences, many of the same words would probably be found in all of the vocabularies. I found sixty-four words used in common by four little girls two years of age.

It is to be hoped that such observations by parents of children who are just learning to talk will soon become common. If those who have begun, or will begin, such observations, will send me the record for several months before the middle of next May (1891), I shall be pleased to compare them, and report the result to the readers of this paper. If any thing of scientific value is obtained, it will be published, and along with it the names of those by whose patient observation it has been obtained. Besides the facts suggested above, the age and sex of the child, and the nationality of the parents, should be sent with the record.

Those who intelligently and sympathetically study the intellectual and emotional development of the child from day to day will find it more interesting than any continued story, and will gain more knowledge of human nature than by reading the most vivid character delineations. E. A. KIRKPATRICK.

Worcester, Mass., Nov. 25.

"ODDS AND ENDS," No. 31, from the literary junk-shop of A. S. Clark, 34 Park Row, New York City, is a well-edited catalogue of new and old books.

BOOK-REVIEWS.

Civilization: An Historical Review of its Elements. By Charles Morris. 2 vols. Chicago, S. C. Griggs & Co. 12°. $4.

This work, as the author states, is not "a history of civilization in the ordinarily accepted sense of the term, but is offered rather as an outline view of its elements, with some attempt to set forth the philosophy of human progress." It opens with a general sketch of the earliest civilized nations, and then treats successively of the development of political institutions, religion and morals, industry, and the other leading elements in the progress of humanity. The author makes no pretence of original investigation into the facts, and seldom descends to details; and he presupposes in the reader a general knowledge of the world's history. He devotes but a small space to the periods before the dawn of historical literature, holding that our information about prehistoric ages is far too scanty to be of much use, and that "the conditions displayed by existing savages are no just example of primitive institutions." Thus the greater part of the book relates to the civilization that began in Egypt and Babylonia, and has since spread over Europe and America; but the partial development of civilization in China and India and in ancient Mexico and Peru is not neglected.

The merit of the work is not of the highest order, yet there is much in it that is good. Its principal defect is in the style, which is diffuse and almost garrulous, the author being apparently troubled with too great a development of the linguistic faculty. The division and arrangement of topics are also such as to cause a good deal of repetition; so that the exposition fills a larger space than is necessary. As for Mr. Morris's philosophy, we do not find in it any thing specially new or striking; but he has evidently studied the works of the best philosophic historians, and has thoroughly mastered all the prevailing theories, yet without making a hobby of any of them. He of course regards the history of civilization as a process of development; yet he makes but little reference to the special doctrines of the evolution school, and little use of their hackneyed phrases. The main defect in Mr. Morris's historical philosophy is his insufficient appreciation of the Greek civilization and of its rank among the various forms of human culture. He dwells on its defects rather than on its excellences; and the reader who got his information wholly from this book would be likely to think that Greece was no more important in the development of civilization than ancient India or modern Germany. Yet there is much in Mr. Morris's exposition that is valuable; and most of his views, we think, are sound, and likely to stand the test of time. On the whole, his work will take a respectable rank among American books, though we cannot say that it is up to the true standard of philosophic history.

AMONG THE PUBLISHERS.

The "Dictionary of Political Economy," which Mr. R. H. Inglis Palgrave, F.R.S., is editing, and which is to be published by Macmillan & Co., is now assuming a definite shape, and the first part is to be out in January. Among the contributors are Professor Ashley of Toronto, Professor Bastable of Dublin, Dr. Bauer of Vienna, Mr. Sydney Buxton, M.P., the Rev. A. Caldecott, Mr. Crump of the Record Office, M. A. Curtois *fils*, the Rev. Dr. W. Cunningham, Major Craigie of the Board of Agriculture, Professor Dunbar of Harvard, Professor Dewey of Boston, Professor F. Y. Edgeworth, Mr. Elliott, M. A. de Foville, Professor Foxwell, Dr. Robert Giffen, Mr. C. A. Harris, Dr. J. K. Ingram, Mr. J. N. Keynes, the Rev. T. J. Lawrence, Professor E. de Leveleye, Mr. R. Lodge, Professor F. W. Maitland, Professor J. E. C. Munro, Professor J. S. Nicholson, Mr. R. E. Prothero, the Rev. L. R. Phelps, Signor Pantaleoni, Mr. D. G. Ritchie, Professor Roberts-Austen, F.R.S., Professor H. Sidgwick, Professor Smith of Columbia, Professor Taussig of Harvard, and the Rev.

Publications received at Editor's Office, Nov. 10-22.

Binet, A. On Double Consciousness. Chicago, Open Court Publ. Co. 93 p. 12°. 50 cents.
Blanford, H. F. An Elementary Geography of India, Burma, and Ceylon. London and New York, Macmillan. 191 p. 16°. 70 cents.
Burgess, W. Modern Fish Culture. Birmingham, Eng., Martin Billing, Son, & Co., Pr. 118 p. 12°. 25 cents.
Church, W. C. The Life of John Ericsson. Vols. I. and II. New York, Scribner. 660 p. 8°. $6.
English Literature, A Chart of, with References. Ed. by G. E. Maclean, Ph.D. Boston, Ginn. 13 p. 8°.
Far and Near. Vol. I. No. 1. November, 1890. *m.* New York, The Critic Co. 16 p. 4°. $1 per year.
Hoyt, D. L. Handbook of Historic Schools of Painting. Boston, Ginn. 210 p. 12°. $1.
Lockyer, J. N. The Meteoritic Hypothesis. London and New York, Macmillan. 560 p. 8°. $5.25.
Morris, C. Civilization, an Historical Review of its Elements. Vols. I. and II. Chicago, Griggs. 1,000 p. 12°. $4.
Myers, P. V. N. Ancient History for Colleges and High Schools. Part II. A History of Rome. Boston, Ginn. 123 p. 12°. $1.10.
Physician's Visiting List for 1891, The. Philadelphia, Blakiston. 16°.

P. H. Wicksteed. The object of the dictionary is to give a statement of the position of political economy at the present time, together with such references to history, law, and commerce, as may be of use. Articles on the main subjects usually dealt with in the works of economic writers will be found in it. Short notices of deceased economists, and of their chief contributions to economic literature, are also included. A list of works of leading living writers will be given at the end of the work. Bibliographical notes will likewise be added to the more important articles, with the titles and dates of publication of the principal books referred to.

—Macmillan & Co. have in press "A Dictionary of Classical Mythology, Religion, Literature, Art, and Antiquities," revised and edited from the German of Dr. Seyffert by H. Nettleship and J. E. Sandys. The work will contain nearly five hundred illustrations.

—In *Lippincott's Magazine* for December, 1890, "The Bermuda Islands" form the subject of an article by H. C. Walsh. These islands lie only about seven hundred miles from our eastern coast, and are rapidly growing in popularity as a winter resort, owing to the beauty of their scenery, their temperate climate, and the entire change of life which they afford. In "Types in Fiction," W. W. Crane takes up the cudgel against those authors "who select some particular locality or district, and take its inhabitants as specimens of a type." He objects to authors devoting their energies to portraying people not as individuals, but as samples of a certain type.

—C. W. Bardeen of Syracuse sends us "A Brief History of the Empire State," written by Welland Hendrick. It is a small quarto of two hundred pages, with many illustrations, and gives a very readable account of the history of New York and its people from the time of Henry Hudson to the present day. The author makes no pretence of original research, but has made good use of his authorities, and presents a considerable amount of matter in a small space. The style is simple yet manly, and distinctly superior to the style of some books written for young people. Mr. Hendrick has wisely confined himself to the affairs of the State, treating those of the Union only so far as to show the part that New York has played in them. We should think that the book would be useful both in the schools and in the families of the Empire State.

—In the *Atlantic* for December Mr. Birge Harrison gives an account of the new rival of the French salon, the National Society of Fine Arts, in a paper entitled "The New Departure in Parisian Art;" Mr. A. T. Mahan, in "The United States Looking Outward," shows the isolation of the country, not only in respect to position, but in regard to trade, and prophesies a change in public opinion, which will free us from our indifference to foreign nations, and open our eyes to the necessity of the defence of our own coasts, and a more active policy of trade with other countries; and there is an essay in the Contributors' Club, on "English and American Spelling," from one who, if his name were known, would be recognized as of highest authority.

—No. 47 of the Riverside Literature Series is a small collection of fables and folk-stories, by Horace E. Scudder. They are mostly selected from the author's previous volumes, the "Book of Fables" and "Book of Folk Stories," and are arranged with reference to the difficulty of reading them. The fables are mostly from Æsop, and are well presented. The folk-tales comprise "Little Red-Riding-Hood," "Puss-in-Boots," "Jack and the Bean-Stalk," and many others. The interest of fables, especially those of Æsop, is perennial, and they convey not a little prudential wisdom; but the fantastic and often stupid folk-stories cannot, it seems to us, have any attraction except for children. To them, however, the whole book will doubtless be interesting, and its simple yet refined style ought to make it a useful reading book.

CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

Nov. 18.—Otis T. Mason, Natural History of the Arrow; William H. Holmes, The Arrow-Maker as a Mineralogist; DeLancey W. Gill, Arrow Flaking (illustrated); Walter Hugh, Arrow Pointing and Feathering (illustrated); Thomas Wilson, Forms of Ancient Arrow-Heads; Weston Flint, Arrows in Modern Archery; W. J. Hoffman, Arrow Poisons; J. G. Bourke, Myths of the Arrow.

Philosophical Society, Washington.

Nov. 22.—Charles F. Marvin, Wind Pressures and the Measurement of Wind-Velocities; William Hallock, The Co efficient of Expansion of Some Rocks.

Natural Science Association of Staten Island.

Nov. 8, Election of Officers.—President, Dr. N. L. Britton; treasurer, Eberhard Faber; recording secretary, Charles F. Simons; corresponding secretary, Arthur Hollick; curator, Jos. C. Thompson.

Dr. Britton alluded to his recent proposition (see *Bulletin Torrey Botanical Club*, vol. xvii. p. 121) to recognize plants which, with greater or less frequency, bear flowers of a color other than the normal hue under the rank of "forms," the difference not being sufficient to class them as varieties. Mr. Hollick exhibited specimens of lignite and pyrite from the recently opened fire-clay beds at Green Ridge. This clay has been mined in this locality to a depth of about thirty feet. It is covered by from six to ten feet of drift, and is undoubtedly of cretaceous age, the same as the Kreischerville clays, the two no doubt being continuous.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—There being a considerable annual income for the purchase of books for the Museum Reference Library of Iowa College, it is desirable to have at hand any and all circulars, specimen sheets, catalogues, etc., of all works on Natural History in general, both foreign and domestic. Circulars of museum supplies, apparatus, etc., etc., desired also. State terms. Address ERWIN H. BARBOUR, Box 1333, Grinnell, Iowa.

WANTED.—A situation as Analytical Chemist is desired by the assistant of the late noted scientist, Dr. Cook, during his 15 years survey of the State of New Jersey. Highest testimonials furnished. Address Prof. EDWIN H. BOGARDUS, New Brunswick, P. O. Box 224, care Prof. F. C Van Dyck.

COULD some one inform me what the ingredients and origin of asphalt as used for street-paving and gathered at Trinidad are? Also how gathered and shipped by natives, and mode of refining by the Warren-Scharf Co. of New York and the Barber Co. of Washington? G. KNIPER, 28 Gunn Block, Grand Rapids, Mich.

WANTED.—A position in a Normal School or College as teacher of Botany, Physiology, Zoology, Embryology, Chemistry, Physics, or German, by a university graduate who has done special work in the above lines. Several years' experience in teaching, and one year as assistant in Biology in a prominent university. Box 396, Greencastle, Ind.

PROFESSOR W. M. DAVIS, Harvard College, Cambridge, Mass., desires to correspond with professional and amateur photographers, from whom he can obtain views of New England landscapes.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I wish to exchange Eastern *Lepidoptera* for those that I do not have, particularly those found in the South. Jos. F. Crandall, Honesdale, Wayne Co., Pa.

To exchange, 1890 Seeger and Guernsey Cyclopedia, containing a complete list of the manufactures and products of the U. S., and address of first hands, cost $6. David R. Lewis, Saybrook, Ill.

For exchange—Nice specimens of Unios alatus, trigonus, parvus, occidens, anadontoides gibbosus, rectus, verucosus, gracilis coccineus, ventricasus, multiplicatus and plicatus cornutus. Margaritana confrogosa, complanata, rugosa. Anadonta edentula, decora, corpulenta, and about 300 of the beautiful Ana suborbiculata. Wanted: Unios from all parts of the world, and sea-shells. Address Dr. W. S. Strode, Bernadotte, Ill.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR. VOL. XVI. No. 409. | NEW YORK, DECEMBER 5, 1890. | SINGLE COPIES, TEN CENTS. $3.50 PER YEAR, IN ADVANCE.

NOTES ON THE HABITS OF SOME COMMON ENGLISH SPIDERS.[1]

SOME years ago I sent to *Nature* (vol. xxiii. p. 149) an account of the behavior of the common small garden-spider when a sounding tuning-fork is brought near. If the fork is made to touch any part of the web, or the twigs or leaves by which the web is supported, the trembling of the web completely deceives the spider; so that, after rapidly finding which radial line is most disturbed, she runs along this one and attempts to secure the tuning-fork. She fails to discover in the cold and polished steel any thing different from her usual food; or rather, being led by instinct to eat that which buzzes, she struggles in vain to find a soft place in the armor of her prey.

On the other hand, if the tuning-fork is brought near one of these little spiders while she is waiting in the centre of her web, she generally drops instantly, but will climb up again as quickly as possible if the vibrating fork is made to touch the web.

More recently Mr. and Mrs. Peckham, who have made an elaborate study of the mental powers of spiders (*Journal of Morphology*, vol. i. p. 383), have repeated these experiments, and have confirmed them in every essential particular.

They found that many geometrical spiders would drop when a vibrating tuning-fork was brought near them, but that after much teasing in this way they would sometimes learn to take no notice. They conclude that this dropping habit is of direct service to them in enabling them to escape from birds or wasps which prey upon them.

While staying recently with Mr. Romanes, in Ross-shire, I made some observations in this connection which are possibly worth recording.

The small geometrical spiders which abounded on the gorse bushes near the sea behaved as described above, while, as I have noticed many times before, the diadema spiders, which also were abundant, were affected in a totally different manner. If the tuning-fork is held near them, they throw up their four front legs, either perpendicularly or even farther back, and as soon as the fork is within reach strike at it so violently that the blow may be plainly heard. A buzzing insect carried near is caught by the diadema spider in this way, and speedily wound up.

There were a number also of small brown geometrical spiders, which I believe were young diademas: these dropped when a sounding tuning-fork was brought near them even more readily than the full-grown little spiders.

[1] From Nature.

Instead of bringing a tuning-fork near the spiders, I made a sudden and high-pitched shout, taking care that my breath should not complicate the situation. The effect, when a great number of spiders were resting on their webs near together, was sufficiently striking. The diademas threw up their legs simultaneously, and struck in the air at the imaginary insect; while the full-grown little spiders, and what I believed to be the young diademas, all dropped out of their webs into the branches below.

The suggestion of Mr. and Mrs. Peckham, that this habit is a protection against wasps, is made the more probable by the difference in the behavior of the full grown diadema, which would certainly not be afraid of a wasp, and the little spiders. However, the tactics of a wasp that I watched left no doubt in my mind that this explanation is correct. The wasp, when I first saw it on a gorse spray, was evidently intent on something. It ran up the spray until it came to the silken tube in which the little spider dwells when not on the web. The spider retreated farther into the tube, while the wasp was struggling among the spines and the silk to dislodge her. After a short time the wasp gave up the attempt, and flew away for a few yards. It then very suddenly darted at another spider, seized her before she had time to drop, and carried her off to a branch close by. This was done so quickly that I could not follow the details of the attack; but it is certain that the wasp, which did not carry a spider a moment before, had, without alighting, taken the spider off her web. It would appear that the dropping habit of the spider has re-acted on the wasp, and has developed in it a speed of attack sufficient to counteract the spider's only means of escape.

I have not found that the little spider is less attracted by low notes than by high. A variety of forks, forceps from a box of chemical weights, or a carpenter's square banged on the knee, all seemed to deceive her equally well; but a vibration of great amplitude causes her to retreat to a place of safety. The spider seems to judge of the necessity for prudence by the violence of the insect rather than by the natural note of its wings. She is terrified by a heated tuning-fork which is not too hot to hold.

Mr. and Mrs. Peckham have formed a low estimate of the spider's intelligence as distinct from instinct. They found that a spider which has the habit of carrying its cocoon was quite satisfied with a lead shot slipped into the silk covering of the eggs, and laboriously carried it about. The following are a few of many experiments which I have made, which lead to the same conclusion. A large diadema which had just caught and wound up a large fly, and had carried it up to

its retreat, left it hanging by a short line, while she proceeded, according to the usual habit of this kind of spider, to carefully clean herself before the meal. Meanwhile I managed to replace the fly by a piece of cork without disturbing the spider. When the toilet was complete, she pulled up the line from which the supposed fly was suspended, and tried to eat the cork. She was a long time trying every part of the cork before she finally let it drop. A piece of an india-rubber ring was twisted up until it had acquired a state (well known to school-boys) of spasmodic recoil. This was placed on the carpet-like web of a large black house-spider, which Mr. Pocock tells me is known to naturalists as *Tegenaria atrica*. These, like other house-spiders, appear to be far more wary than the geometrical sort. The india-rubber was made to move slightly by being pinched from below, and then the spider pounced upon it. I did not allow the spider to carry it off, but made it seem to struggle and resist by manipulation with a pair of forceps under the web. The spider became more and more desperate, and at last, when the web was much damaged by the battle, I dragged the rubber away; but the spider could not allow this, and clambering through the hole made in the web, and hanging by her fourth pair of legs, seized the escaping insect. I then let go, and the spider carried the piece of india-rubber away to her den, perfectly satisfied. However, she did not seem to appreciate her meal, for, after biting it on every side, she was obliged to take it to the edge of her web and drop it. I then picked it up, and was surprised to find the spider willing to be similarly deceived again.

These spiders will come to a tuning-fork once or twice perhaps, but the moment they touch it they fly terrified, as they do from a common bluebottle with mica on its wings. They seem generally thirsty, and will drink water placed upon the web; and if it is scattered in drops, they are able to find the drops, but by what process I do not know. The diademas, too, especially when old, and only able to mend old webs, not to spin new ones, are always ready to drink. They will hold a piece of wheat straw six or eight inches long which has a drop of water upon it until they have drunk the water; but while the little spider is so insensitive in taste as not to entirely reject a fly that has been soaking in a paraffine lamp, especially if it is made to buzz with a tuning-fork, the diadema has a strong objection to alcohol, even well diluted, and rubs her mouth against any thing near by after tasting it, so as to get rid as quickly as possible of the noxious fluid. Is it possible that the numerous spiders which are found in secondary batteries have been killed by the acid when attempting to drink, or are they destroyed by accidentally meeting the acid in their ordinary descents? The *Tegenaria* is aware of the shout which causes the diadema to strike and the little spider to drop, but the effect is a jump such as is executed by any one when suddenly startled.

It would appear that the only sense which is developed to any extent, and that most marvellously, is the sense of touch; hearing, taste, and smell to a small degree; but sight, as we understand the term, in spite of their numerous eyes, seems to be absent. The *Tegenaria* will stand within half an inch of a fly feigning death, without being able to find it; while the geometrical spiders, under like circumstances, gently pluck line by line until the effect of the inertia (not weight) of a motionless object guides them to the proper place.

These remarks do not apply to the hunting spiders.

C. V. Boys.

THE PRODUCTION OF IMMUNITY FROM DISEASE.

A recent despatch to the newspapers stated that Koch's consumption "lymph" had been analyzed by a Vienna doctor, and that the principal ingredient was found to be a substance which the chemists know as albumose. Professor Koch himself, in his articles to the medical papers, does not give the method of preparation of the "lymph," but indicates that the material used is a sterilized culture liquid of the germ that causes tuberculosis.

This being the case, it is of interest to call attention to the fact that the principle which Professor Koch is applying received its first proof in a study of the fatal disease of hogs, known as hog-cholera, made by Drs. Salmon and Smith of the Bureau of Animal Industry, Department of Agriculture, Washington, D.C., in 1887. To explain clearly what has been done, it is a well-known fact that the germs which cause different diseases in men and animals can be isolated, and caused to multiply artificially outside of the body, by supplying them with food. Some germs require one sort of material, others a different one; but in general it may be said that beef-broth, or blood serum, or glycerine and gelatine, are the most useful substances. These prepared solutions are called culture liquids, or culture media. Into a tube or flask of the liquid are introduced a few of the germs it is desired to cultivate, and in a short time the germs are found to have increased so enormously that they can be seen by the naked eye. During this time great changes have taken place in the culture solutions: what was at first harmless beef-broth has been changed by the action of the germ to a liquid, which, after the germs have been removed by filtration or killed by heat, still contains poisonous alkaloids and albuminoids, which are generally fatal in their effects upon the animal body. Alkaloids formed in this way are called ptomaines; and the albuminoid bodies, albumoses; and each distinct disease-germ forms a peculiar and distinct ptomaine and albumose. The growth of the germ in the body is supposed to form ptomaines and albumoses from the blood and tissues, and these substances cause the fatal effects of the different diseases.

A horse can be gradually accustomed to arsenic; a man, to opium, nicotine, strychnine, and quinia: so that after a time a dose which would at first have been fatal to him can be taken without injury. The idea suggests itself at once, why not prepare and isolate the poisonous substances which germs form, give them in small doses to men and animals, thus gradually accustoming the body to their effect; and if then the disease-germ afterwards enters the body, the system will be already fortified against the poison which is produced, and able to resist what would otherwise be its bad effects.

This is exactly what Dr. E. A. v. Schweinitz, physiological chemist in the Department of Agriculture at Washington, D.C., has done in the case of the two diseases of hogs which cause such enormous losses to the farmers of the country; viz., hog-cholera and swine-plague. Dr. Schweinitz has made

considerable quantities of culture media, and by chemical methods isolated and extracted the ptomaines and albumoses that the germs form.

These poisonous liquids have been injected into guinea-pigs, and the animals then inoculated with the virus of the disease. The guinea-pigs which had thus been treated were not seriously affected by the virus, while the guinea-pigs which had not been treated by injecting the remedy invariably died. Both swine-plague and hog-cholera have thus been prevented in guinea-pigs, which are very susceptible to the diseases.

Some experiments have also been made upon hogs, which have been fairly successful; and there is every reason to expect that this method of treatment can shortly be applied on a practical scale. It may be mentioned that the scientific results of these experiments were published in the Philadelphia *Medical News* of September and October, 1890.

While Professor Koch has been working for the benefit of mankind, the secretary of agriculture of the United States has had the pecuniary interests of the farmer and the safety of animals at heart in encouraging this difficult line of investigation; and results have been secured which are far-reaching in their importance and application for men as well as animals.

Professor Koch, in treating consumption, uses a solution the composition of which he says he does not know. The Department of Agriculture uses substances which are obtained in a solid form, as most drugs, and prepares solutions of any desired strength for treating the diseases of hog-cholera and swine-plague.

There is no reason why this line of research should not be pushed with reference to many diseases of men and animals in the large universities and laboratories of our own country. In the hands of competent investigators, there can be secured in the United States the most important results, and great discoveries can be made. The Scientific Department of the government has shown the way. Let others follow.

SPECIAL PLANTING FOR HONEY.

It is a well-known fact, and as thoroughly appreciated by the thoughtful bee-keeper, that often, because of some peculiar condition of the weather, even our best honey-plants fail to secrete nectar. In Michigan the years 1888 and 1890, and to a less degree 1889, gave excellent illustration of this fact in respect to white clover.

Again, it frequently occurs that a drouth or over-production the previous season so weakens plants that they do not develop to the blossoming stage, or do not produce blossoms. This very season, 1890, gave us almost no basswood bloom. The same truth is illustrated not infrequently by almost all of our nectar-secreting plants.

Once more, there are times in every season and region when there is a dearth of nectar-secreting flowers. In Michigan this period comes about July and August, usually from about July 15 to Aug. 15. At this season there are neither native honey-plants in bloom, nor are there honey-plants in cultivation. So at this season the bees are idle, and robbing is a common occurrence.

For the above reasons bee-keepers are much interested to know if there are plants that will always secrete nectar irrespective of weather,—plants that will secrete not simply enough to attract bees, but enough to give a surplus and insure a profit. They are also practically interested in knowing whether or not there are plants that will secrete so liberally that it will pay to grow them for honey alone. It is further a matter of importance to find if there are plants that bloom at the time of the honey-dearth in July and August, and so, valuable to grow, either for honey alone or for honey and other purposes. There are always more or less waste places, by roadsides, along railways, etc., near by most apiaries. It is important to know if it will pay to utilize such by planting for honey, and, if so, to know what to plant.

That these are important matters for investigation is clear from the fact that many bee-keepers have spent considerable sums in trying to solve these questions.

It is clear, that, to arrive at any definite and reliable conclusions, experiments must be tried on a large scale. We must not see simply that bees work on the flowers, but we must get results. We must be assured that the bees actually store, and that in paying quantities.

It occurred to me, and to the board of our Michigan experiment station, that this was a very proper subject for investigation at our station, and so for the past two seasons we have devoted about fourteen acres to this purpose. The seasons have been very opportune, as there was an almost total failure in the honey-harvest both years; and so, if any plan adopted was a success, it would have ample chance to prove its excellence.

I decided to try the three following honey-plants: Rocky Mountain bee-plant (*Cleome integrifolia*), Chapman honey-plant (*Echinops spherocephalus*), and a foreign mint of the genus *Melissa*. I hoped to find a plant that would secrete nectar every year, especially in times of drouth, that would grow with little or no care on the part of the bee-keeper, and would yield bountifully of nectar. As the Chapman honey-plant was loudly praised, and was reported a success upon actual trial, and as the seed had been distributed by the government, it occurred to me that it should be one of the plants first tested. The Rocky Mountain bee plant flourishes on the dry plains of Colorado, where it is said to give prodigious yields of nectar; and as I had been quite successful in growing it in small plats for years, where it seemed to attract the bees from early July till frost, I looked upon that plant as well worthy a trial. This plant is also reported as growing wild in Wisconsin and Minnesota, and as affording much nectar. The *Melissa* belongs to the mint family,—a family of honey-plants,—is strongly praised by those who have tried it, and who have no pecuniary interest in its becoming popular: so I concluded to make it third in the list to be adopted.

The Chapman Honey-Plant.

I have planted, in all, four or five acres of the seed of this plant, some on clay and others on sand. When the seed came, the plants made a very vigorous growth, but did not blossom at all the first year. Thus the plant is a biennial. No nectar can be secured from it until the second year after planting. The plant looks like a thistle, the spines doubtless suggesting the generic name *Echinops*. The flowers form a very perfect globe or sphere; hence the specific name *spherocephalus* is very appropriate. The plant, if cultivated till once well started, will care for itself, as it is very vigorous. It begins to bloom here at the Michigan Agricultural College about the middle of July, and continues to blossom till the middle of August. The blossoms commence to open at the lower margin of the head, and continue to open towards the centre. The seasons have been very dry, yet the bees visited the *Echinops* very freely, and secured considerable honey; and this, too, just at the most desirable period of the year.

A very serious objection to the general adoption of this plant is the difficulty of securing the seed. The chaff has barbed awns, that are very minute. These fly everywhere as we clean the seed, and, except one is protected better than he will be unless previously taught by experience, these awns are sure to enter the eyes and pierce the skin at every possible opportunity. The effect of this is almost maddening. For three or four days the pain in the wounded eyes and skin is almost unendurable.

After the plants bear a full crop of seed they seem exhausted, and very few survive to blossom the second year. Our plants in 1889 were wonderfully fine and vigorous: the plants on the same area this year are very few and scattering. To be sure, young plants have come up thickly from seed, but they will bear no bloom till 1891. Thus we see that we cannot grow this plant profitably except as we plant, or permit it to self-plant, every

year, and also that we get no honey till the second season from the seed.

Another serious difficulty is the chance that the seeds may not come. I planted five acres of seed this spring. The seed seemed excellent, the ground was in fine condition, and we had frequent and abundant rains; yet so few of the seeds came, that I ploughed all up, and sowed to buckwheat.

We see, then, that the special planting for honey alone, of the *Echinops*, is not encouraging. The fact that the plant is a biennial, that it is so terrible to thresh, that the seed is likely to fail to germinate, and the fact, if we may judge from analogy, that the plant may not always secrete nectar even though it bloom profusely (our experiments do not prove or refute this point),—all would tend to make the wise bee-keeper hesitate before he grew this plant. It seems more than probable that it will never pay to do so.

The Rocky Mountain Bee-Plant.

I had previously learned that to grow *Cleome* we must plant in autumn. Spring-sown seed will rarely germinate. So in the fall of 1888 I sowed eight acres of *Cleome*. The seed was procured fresh from Colorado. To my great disappointment, the seed did not germinate well. In many places the plants were exceedingly scattering. These plants were on sandy land. Other seed was planted on clay, and did not germinate nearly as well as that sown on sand. The blossoms commenced to open the first of July, and continued to bloom even into September. The season was very dry, the excessive drouth reaching from July till late autumn,—just the time for a Colorado plant to show its virtues. The plant grows from one to three feet high, the foliage is smooth, the leaves compound, and the flower an umbel. The flowerets commence to open below, and continue for a long time.

To my great disappointment, the flowers seemed to furnish very little nectar. The bees worked on the plants only occasionally, and then not excessively. Thus there were two disappointments,—failure of the seeds to germinate, and failure of the flowers to secrete.

We sowed in 1889 three acres with seed of our own raising, which failed almost entirely to germinate. We left three acres uncultivated where the plants were thickest in 1889, to see if the plants would self-seed the ground. Here, too, we were disappointed. There were so few plants, even though the season seemed exceptionally favorable, that both pieces—the one planted and the one supposed self-sown—were ploughed up.

Thus these plants, like the *Echinops*, two as promising species as we could hope to find, promise little in the way of special planting exclusively for honey. The expense and labor; the doubt of growing a crop even though we plant; the chance that the season may not be propitious, and so there be little or no nectar secreted, even though the plants do grow and bloom,—all this makes the prospects for profit in such planting not encouraging.

Melissa.

The *Melissa* is an annual. We planted it for two successive years. It did well, blossomed freely, and was visited very generally by the bees. It grows well on both sand and clay, and, by sowing early, will commence to bloom early in July, and continue in bloom for a month or more. I regret to say that it will not self-seed, and must be planted annually. This is expensive, and it is doubtful if it will pay. It is to be said, however, that *Melissa*, in common with the other mints, seems to attract the bees at all times of bloom, whatever the season: so I am of the opinion, that, if any plant will pay exclusively as a honey-plant, it will be some mint. Many of these are perennial. As the three acres of *Melissa* last season *were* singing with bees all through the time of blossoming, and as our bees swarmed in early August, a thing unprecedented in Michigan, it gives reason to hope, that, with a large average, we might secure a honey-crop each year despite the season.

Thus I believe our experiments indicate that special planting for honey alone is of doubtful practicability; that *Echinops* and *Cleome*, at least, are not the plants for such special planting, if it is ever to be a success; and that while *Melissa*, or bee-balm, is not profitable, as it is an annual, it is possible that the perennial mints are the plants, if any such there be, that will pay us to grow exclusively as honey-plants.

Unless *Cleome* will seed itself, it is not the plant even for wayside planting. I think we must look to some of the persistent mints, or, more probably, to some plant valuable for other purposes even, to plant on the roadside and in waste places.

I hope next to try *Melilot*, or sweet clover, not so much to find whether it is a valuable honey-plant, as we know that now, but rather to find if this luxuriant and vigorous clover may not have other important uses, possibly for silage. I shall also hope to plant small beds of promising mints, in hopes for hints of some plant that will pay just for nectar, and nothing else.

A. J. COOK.

THE RELATION OF GROUND WATER TO DISEASE.

AT the meeting this year of the Royal Meteorological Society, held on Nov. 19, the president, Mr. Baldwin Latham, delivered an address on the above subject.

The pages of history show that when the ground waters of our own or other countries have arrived at a considerable degree of lowness, as evidenced by the failure of springs and the drying-up of rivers, such periods have always been accompanied or followed by epidemic disease. In all probability, ground water in itself, except under conditions where it is liable to pollution, has no material effect in producing or spreading disease. As a rule, it is only in those places in which there has been a considerable amount of impurity stored in the soil that diseases become manifest; and the most common modes by which diseases are, in all probability, disseminated, are by means of the water-supplies drawn from the ground, or by the elimination of ground air into the habitations of the people. It is found that the periods of low and high water mark those epochs when certain organic changes are taking place in the impurities stored in the ground, which ultimately become the cause, and lead to the spread, of disease. Mr. Latham defines "ground water" as all water found in the surface soil of the earth's crust, except such as may be in combination with the materials forming the crust of the earth. It is usually derived from rainfall by percolation, and it is also produced by condensation. In dry countries, ground water is principally supplied by the infiltration from rivers, as, for example, in the Delta of the Nile.

The absence of water passing into the ground for a long period, naturally leads to the lowering of the free ground water-line, and may lead to the drying of the ground above the water-line; and it is curious to note, with reference to small-pox, that the periods marking the epochs of this disease are those in which there has been a long absence of percolation, and a consequent drying of the ground preceding such epidemics. On the other hand, small-pox is unknown at such periods as when the ground has never been allowed to dry, or is receiving moisture by condensation or capillarity.

The study of underground water shows that certain diseases are more rife when waters are high in the ground, and others when the water is low. The conditions that bring about and accompany low water, however, have by far the most potential influence on health, as all low-water years are, without exception, unhealthy. As a rule, the years of high water are usually healthy, except, as often happens, when high water follows immediately upon marked low water, when, on the rise of the water, an unhealthy period invariably follows.

Mr. Latham has found that those districts which draw their water-supplies direct from the ground are usually more subject to epidemics and disease than those districts in which the water-supply is drawn from rivers supplied from more extended areas, or from sources not liable to underground pollution. In the case of Croydon, one portion of the district (under three-fourths) is supplied with water taken direct from the ground, whilst the remaining portion is supplied with water from the river Thames. It is curious to note, that, even so recently as 1885, the zymotic death-rate in the districts supplied with underground water was twice as great as in that part of the district supplied from the Thames; and

in this particular year 41 deaths from small-pox occurred in the district, not one of which was recorded outside the district supplied by the underground water.

Mr. Latham, in his address, dealt largely with zymotic diseases as affected by ground water, and showed that cholera ordinarily breaks out when there is the least ground water; a high air and ground temperature is also necessary for its development; and, as a rule, the low-lying districts are favorable to the production of these high temperatures. Small-pox is almost always preceded by a long period of dryness of the ground, as measured by the absence of percolation. Typhoid-fever is most prevalent after a dry period, and the first wetting of the ground or percolation from any cause takes place. The condition essential to the development of diphtheria is a damp state of the ground marked by extreme sensitiveness to percolation of rain. Scarlet-fever follows the state of the dryness of the ground which is essential for its development, and it occurs in the percolation period. The conditions that precede small-pox are those favorable for the development of scarlet-fever, and, like small-pox, the dampness of the ground for any considerable period in any particular locality may check its development or render it less virulent, and it is most rife in low-water years. Measles are least prevalent at the low-water periods, and mostly rife at and near high-water periods. Whooping-cough follows the percolation period in its incidence, increasing with percolation, and diminishing as the waters in the ground subside. Diarrhœa is generally more prevalent in a low-water year than in other years; that is, with a very much colder temperature in a low-water year there is a very much higher death-rate from this disease.

Mr. Latham finds that the general death-rate of a district is amenable to the state of the ground water, years of drought and low water being always the most unhealthy.

HEALTH MATTERS.

A Faster in the Seventeenth Century.

Now that Succi, the Italian fasting man, is attracting universal attention, it may be interesting to recall a case of total abstinence from food for forty days, which occurred more than two centuries ago. In the winter of 1684, according to *The Hospital*, a certain Isaac Henry Stiphont of Haarlem was confined in a lunatic-asylum. At this date he was forty years old, and, although born of an insane mother, had learned a handicraft, married, and conducted himself like other people, until, in the previous autumn, he quarrelled with his brother-in-law, and in a scuffle accidentally broke the man's leg, when the fear of falling into the hands of justice drove him mad. He had been in the asylum a few months, when he suddenly took it into his head that he was the Messiah, and resolved to fast forty days and forty nights. Accordingly, on Dec. 6 he began to abstain from all food, and continued to do so until Jan. 15, 1685. During all this time he took no sustenance whatever. Nothing passed his lips but an occasional sip of water for the purpose of cleansing his mouth. If a little broth or brandy was put into the water, he discovered the addition instantly, and thrust the cup away untasted. Every effort was made to persuade or compel him to take food. It was even sought to influence him by the pretended apparition of an angel, who brought to him the express command of God that he should eat. He does not appear to have doubted the reality of the visitation, but continued to declare that it was the will of his heavenly Father that he should fast forty days and forty nights. Stiphont had been a smoker before the commencement of his fast, and continued the daily use of tobacco during the whole time of his abstinence from food. The case had excited great interest, and when the fast was ended the doctors desired the man to take some medicine to stimulate the action of the stomach. He refused, and would only take fish and a special soup to be prepared by his wife. So singular an occurrence made a great noise at the time. Some people ascribed it to a miracle, others to the combined effect of madness and tobacco. A madman, it was said, could endure a temperature that froze his companions; so, if insanity made a man impervious to cold, why should it not render him insensible to hunger? The wild hordes of Canada were known, during times of scarcity, to exist for weeks upon water and tobacco, so why should not Stiphont, the civilized, do the same by the help of his madness?

Deafness for High Notes.

We learn from the *Medical Record* of Nov. 29 that Mr. Edwin Cowles, editor of the *Cleveland Leader*, who died last March, had a peculiar form of deafness. He never heard the sound of a bird's note, and until he grew to manhood he always thought the music of the bird was a poetical fiction. "You may fill the room with canary birds," he once said, "and they may all sing at once, and I would never hear a note, but I would hear the fluttering of their wings. I never heard the hissing sound in the human voice: consequently, not knowing of the existence of that sound, I grew up to manhood without ever making it in my speech. A portion of the consonants I never hear, yet I can hear all the vowels. About a quarter of the sounds in the human voice I never hear, and I have to watch the motion of the lips and be governed by the sense of the remarks, in order to understand what is said to me. I have walked by the side of a policeman going home at night, and seen him blow his whistle, and I never could hear it, although it could be heard by others half a mile away. I never heard the upper notes of the piano, violin, or other musical instruments, although I would hear all the lower notes."

Summer Drinks.

The *Medical Record* of Calcutta contains some interesting remarks upon the beneficial effects to be derived from non-alcoholic drinks in the height of summer, says the *Lancet*. After remarking that the very bane of European existence in India lies in the habits of eating and drinking, physiological arguments are adduced to show that highly carbonized materials are very deleterious in hot climates. The custom of the Moguls, who for luxury have had no equal in Indian history, is referred to as offering a fitting example. Their drinks consisted of milk, sweetened waters, or sherbets prepared from sub acid fruits, such as lemons, tamarinds, pomegranates, etc., flavored with rose or Keora essences, date-juice, numerous vegetable tisanes, and some infusions of glutinous seeds flavored with sugar and essential oils. These were often cooled with ice collected in pits, where it was stored during the winter months. The Oriental races, it is asserted, suffer from few of the diseases which are common to the copious meat-eating, wine-drinking Europeans. For a hot day, a light vegetable diet is recommended, with a spare quantity of meat food and an abundance of cooling, non-alcoholic drinks. Ice is regarded as a necessity, and coffee, tea, and cocoa are to take the place of whiskey-and-soda. The use of aërated waters, prepared from pure and wholesome ingredients, and the admixture in them of the numerous fruit flavorings which abound in the tropics, are regarded with favor, as likely to offer a lucrative source of income to persons engaged in such trade, while also giving the European community a very acceptable form of summer drinks.

Antiseptics among the Ancient Greeks.

Professor Anagostakis of Athens has published some interesting facts in reference to the employment of antiseptic measures among the ancient Greeks, as we learn from the *Druggists' Circular*. Hippocrates and Galen were aware that an unclean condition of wounds retarded healing. They were also well acquainted with the fact that by thorough hæmostasis, suture, and the employment of antiseptic measures, infection of wounds might be prevented. Hippocrates warned his disciples against the use of moist dressings, on account of the danger of suppuration, and forbade the employment of drugs before the wound was dry. Above all, says Galen, avoid dirt, as it prevents healing. The ancient Greeks boiled their water before applying it to wounds. Sponges were avoided, and charpie recommended in their stead, which was to be destroyed after use. One of the principal antiseptic substances then in use was wine, which was usually heated before using, and with which, according to Hippocrates, all wounds were to be washed. Dressings dipped in wine were also applied to the wound. Salt was in very general use, either in solution or in the form of sea-water. The solutions were rendered aseptic by boiling. Sulphate of copper was relied upon as an antiseptic for foul wounds, and

was also put into use as a hæmostatic. Tar was highly praised for its antiseptic virtues, and was either applied in the form of a dressing or directly poured upon the wound. Besides these, many aromatics and bitters were in daily usage, among which were thyme, rosin, asphaltum, etc., used as dressings or in the form of plasters. Galen was acquainted with catgut, and advised the use of non-putrefying substances for sutures. Professor Anagostakis declares that all this was not empiricism, but an antiseptic method founded upon some knowledge of the principles governing the healing of wounds.

NOTES AND NEWS.

AT the meeting of the American Naturalists, Dec. 31, 1890, at Boston, the topic will be "The Inheritance of Acquired Characteristics." It will be presented from several points of view by the following speakers: Professor H. F. Osborn, W. H. Brewer, W. K. Brooks, W. G. Farlow.

— From the first of January, Dr. Richard Andree, 27 Leopoldstrasse, Heidelberg, will be the editor of *Globus*, which was founded nearly thirty years ago by his father, recently deceased.

— A quaint custom, dating back to Anglo-Saxon times, known as payment of "wrath silver," was recently observed at Knightlow Hill, a tumulus between Rugby and Coventry, England. It consists of tribute payable by certain parishes in Warwickshire to the Duke of Buccleuch. The silver has to be deposited at daybreak in a hollow stone by representatives of the parishes, the penalty for default being forfeiture of a white bull with a red nose and ears. The representatives afterwards dined together at the duke's expense.

—In the *Meteorologische Zeitschrift* for October, M. Nils Ekholm gives an account of a method on trial at the Meteorological Office of Stockholm, which seems likely to throw some light upon what has hitherto been a difficult matter to deal with; namely, the determination of the path taken by storms. He calculates, from the telegraphic weather reports, tables of the density of the atmosphere, and constructs from the data synoptic charts of this element, and finds that they give a better clew to the movements and origin of cyclones than the usual method of a comparison of the isobars and isotherms alone. He finds, as stated in *Nature*, that storms move in the direction of the warmest and dampest air, parallel to the lines of equal density, leaving the rarer air to the right hand. A few empirical rules are quoted from about a hundred cases which have been investigated.

— Ginn & Co. announce to be ready Dec. 20, "Good-Night Poetry," by Mr. W. P. Garrison. The idea of this book is that "the thoughts and feelings that are in the mind as it bids the world good-night have the hours that follow for undisturbed working on the quality of the brain. For moral culture, these last minutes are decisive. We must gain them for what is true and good; and poetry is the voice they will hear most willingly."

— At the eighth congress of the American Ornithologists' Union, held at the United States National Museum, Washington, Nov. 18–20, the papers read were as follows: "The American Ornithologists' Union—A Seven Years' Retrospect," an address by the retiring president, by J. A. Allen; "Seed-Planting by Birds," by Walter B. Barrows; "Phalaropes at Swampscott, Mass.," by William A. Jeffries; "The Birds of Andros Island, Bahamas," by John I. Northrop; "Remarks on a Few Species of Andros Island Birds, collected by Dr. Northrop," by J. A. Allen; "An Experimental Trial of a New Method for the Study of Bird-Migration," by Harry Gordon White; "A Study of Bird-Waves in the Delaware Valley during the Spring Migration of 1890," by Witmer Stone; "Our Present Knowledge of the Neotropical Avifauna," by Frank M. Chapman; "The case of Colaptes auratus and C. cafer," by J. A. Allen; "Observations upon the Classification of the United States Accipitres, based upon a Study of their Osteology," by R. W. Shufeldt; "Some Observations on the Breeding of Dendroica vigorsii at Raleigh, N.C.," by C. S. Brimley; "The Trans-Appalachian Movement of Birds from the Interior to the South Atlantic States, viewed Chiefly from the Standpoint of Chester County, S.C.," by Leverett M. Loomis; "A Further Review of the Avian Fauna of Chester County, S.C.," by Leverett M. Loomis; "Some Bird Skeletons from Guadalupe Island," by Frederic A. Lucas; "The Present Status of the Ivory-billed Woodpecker," by E. M. Hasbrouck; "Some Notes concerning the Evening Grossbeak," by Amos W. Butler; "Owls of Illinois," by W. S. Strode; "The Spring Migration of the Red Phalarope, Crymophilus fulicarius," by Harry Gordon White; "On the Tongue of Humming Birds," by Frederic A. Lucas; "Instinct, Intuition, and Intelligence," by C. F. Amery; "The Habits of the American Golden Plover in Massachusetts," by George H. Mackay; "Correction to Revised Catalogue of the Birds of Kansas," by N. S. Goss; "Second Occurrence of the White-Faced Glossy Ibis, Plegadis Guarauna, in Kansas," by N. S. Goss; and "Remarks on the Primary Faunal Divisions of North America," by C. Hart Merriam.

—*The Scottish Geographical Magazine* for November is authority for the statement that a submerged city has been discovered between Grado and Pola in Istria, which very likely will prove to be the ruins of the town of Cissa, mentioned by Pliny and Decimus Secundinus as situated upon an island of the same name. The position of its site being doubtful, considerable interest has frequently been evoked by attempts to identify it, which, however, have hitherto failed. A diver who has examined the newly discovered remains reports that the walls of buildings and streets can be clearly traced, and that he followed a sea-wall for a hundred feet, and might have been able to proceed along it for a greater distance had not the apparatus which supplied him with air prevented his further progress, while the depth of water beyond the wall forbade any attempt to examine its frontage. No signs of doors or windows were observed; but these, he considered, were blocked up and hidden by *débris* and marine growths. Further investigations are to be carried out, which, it is hoped, will do much to clear up the mystery that has so long hung over Cissa, its position, and its fate.

—Mr. T. Tuhlin has recently published in the *Nova Acta* of the Royal Society of Sciences of Upsala a paper on the nocturnal temperature of the air at different heights up to twenty-four feet, from hourly observations taken during the winters of 1887 and 1888, in the grounds of the Upsala Observatory. The observations were made mostly while snow lay upon the ground, with thermometers both with and without screens, and were intended to form a sequel to the series made by Mr. H E. Hamberg during the summer season. The first part of the paper, according to *Nature* of Nov. 20, contains a *résumé* of the experiments made since 1778. The following are some of the chief results arrived at in the second part of the paper. The decrease of temperature by radiation from unprotected thermometers over snow remained almost constant at heights above half a metre. During clear nights the temperature increased with height, from two or three hours before sunset until two hours after sunrise; and the lower the temperature, the greater was the increase. During cloudy or foggy nights the temperatures at different heights were nearly equal; but, if the clouds were high and thin, the increase of temperature with height was only slightly hindered. The surface of the snow was found to be colder than the surrounding air.

—The movement for better roads which is so prevalent in many States has resulted in Pennsylvania in the appointment of a road commission by the legislature and governor, to investigate the road laws and formulate a better system. With the same end in view, the committee on better roads, a committee of citizens of Philadelphia, offered, through the University of Pennsylvania, prizes amounting to $700, for the best papers on road making and maintenance, embodying the engineering, economic, and legislative features of the problem. A large number of contributions were received and referred by Dr. William Pepper, provost of the university, to a board of adjudicators appointed by him, composed of Alexander J. Cassatt, C.E., chairman; William Sellers, M.E.; Joseph M. Wilson, C.E.; William H. Wahl, Ph.D.; Thomas M. Cleeman, C.E.; Hon. Wayne MacVeagh; and Professor Lewis M. Haupt, C.E., secretary. During the examination of the papers, and until the awards were made, their authors remained entirely unknown to the board, which, after due consideration, awarded the first prize, of $400, to Henry Irwin, B.S., C.E., assistant engineer Canadian Pacific Railway, Montreal, Canada; the second

prize, of $200, to David H. Bergey, B.Sc., M.D., North Wales, Penn.; and the third prize, of $100, to James Bradford Olcott, practitioner and writer upon the subject, South Manchester, Conn.; and honorable mention, without reference to order, to Edwin Satterthwait (president of the Cheltenham and Willow Grove Turnpike Company, Jenkintown, Penn.), Charles Punchard (former surveyor of roads in England, Philadelphia, Penn.), George B. Fleece, C.E. (Memphis, Tenn.), Frank Cawley, B.S. (instructor in engineering, Swarthmore, Penn.), and Francis Fuller McKenzie, C.E. (Germantown, Penn.). These, together with a careful digest of the remaining papers prepared by Professor Lewis M. Haupt, C.E., head of the civil-engineering department of the university, and secretary of the committee on better roads, and a short paper, also written by by him, discussing the general features of the contributions, with some notes on the adaptation of soils to foundations (all of which has been copyrighted by William H. Rhawn, chairman of the committee), will be published in one volume by Henry Carey Baird & Co., Philadelphia.

—*The Canadian Gazette* of Aug. 7, 1890, states that Sable Island is disappearing. This island, which lies in latitude 44° north, and longitude 60° west, was not very long ago forty miles long, whereas it is now only twenty miles. Since 1880 three lighthouses have been built on it, of which two have been washed away, and the third is being rapidly undermined by the waves.

—Two great authorities on social matters have lately expressed their personal opinion on the results of modern education as to its effects upon the well-being of the population. Prince Bismarck thinks that higher education for the lower classes has been too widely spread (*British Medical Journal*), and in a recent conversation is reported to have said, "Over-education in Germany leads to much disappointment and dissatisfaction; in Russia, to disaffection and conspiracy. Ten times as many young people are educated there for the higher walks of life as there are places to give them, or opportunities for them, in the liberal professions, to earn a decent living, far less wealth and distinction. Perhaps it is not quite the right kind of learning, too. What good does it do them? When they have gone through it, in nine cases out of ten there is nothing for them to do; and their learning is worse than a superfluity to them, for it makes them discontented, nay, miserable." Mr. Gladstone takes a different view, but believes that classical education should only be given to those likely to profit by it in after-life. He is strongly desirous to promote physical and corporal education generally, and attaches much value to the training of the eye and the hand. For this purpose he urges that some branch of natural history should have a higher place in the modern theories of education than it has yet obtained. In these days, when many medical men see reason to believe that education in too many cases exhausts and injures the nervous system, in place of developing and strengthening it, it is interesting to know the opinion of great statesmen of experience. The question is a very serious one, and demands inquiry as to the effects of the present educational systems upon the brains of the young.

—A report has lately been issued by the Chinese commissioner of customs at Newchwang, as stated in *The Scottish Geographical Magazine* for November, in which some interesting particulars are given regarding the means of transport existing in Manchuria. The roads are mere tracks of frozen mud, impassable in wet weather. The late harvest has been exceedingly abundant, and peas, beans, and oil have poured into Newchwang, as many as two thousand carts arriving daily when the tracks were hard-frozen, and about one thousand per day when the roads were in a less favorable state for traffic. The smaller carts are drawn by a cow with a couple of donkeys in the traces, and carry a load of sixteen piculs (a little over 113 pounds). Medium-sized carts are drawn by five animals, and can make a journey of four or five days with a load of thirty-three piculs. The largest carts are dragged along by a small horse in the shafts, with six mules, three abreast, and can make a twenty days' journey. They are mostly used for the transport of beans. The oil carts are drawn by mules only, under the care of a couple of drivers, — one walking beside the team, while the other, sitting on the top of the load, wields the whip. These teams generally make a journey of thirty or forty consecutive days, the animals resting all night in the inn yards, without shelter or clothing, under a semi-arctic climate. The commissioner confidently expects that railways constructed to Newchwang will have their usual marked effect on trade. Newchwang is situated near the Yellow Sea, and is the most northerly port of China open to foreign trade.

—The warmest place in Europe is Malaga. *The Scottish Geographical Magazine* states that it is warmer even than the Algerian coast. The mean of the daily maxima is 66.4° F., and the month of August enjoys the tropical temperature of 80.8°, while the absolute maximum reaches 110°, and the minimum, in the exceptionally cold year of 1885, was 32°. There are only forty-eight rainy days in the year. The sugar-cane and the *cherimoya* grow in the neighborhood.

—Lieut. Ryder has given, in *Petermann's Mitteilungen* (Bd. 36, No. viii.), details of the plan he intends to follow when he leads the Danish Expedition to Greenland, as announced in *The Scottish Geographical Magazine*, vol. vi. p. 270. The coast to be explored may be divided into two stretches. The first extends from Franz Josef Fiord to Cape Brewster, latitude 70° north. Scoresby drew a map of this coast in 1822; but, the main object of his voyage being to hunt whales, he could only land twice or thrice, and did not explore the inlets which penetrate far into the land between Franz Josef Fiord and Scoresby Sound. From Cape Brewster to Angmagsalik the coast is hardly known at all: it was sighted by Scoresby in 1822, and by the French naval officer, Jules de Blosseville, in 1833. Capt Holm draughted a map of it from sketches and information supplied by the Eskimo, from which it appears that the inland ice approaches very close to the coast, and for a considerable distance descends into the sea. The expedition is to consist of nine persons,—two naval officers, a scientist, four sailors, and probably two Greenlanders from the Danish colonies on the West Coast. They will be furnished with three boats (each 22 feet long by 6 broad), a house, sleighs, tents, fire-arms, etc. They will leave Copenhagen at the beginning of June, 1891, and endeavor to form a depot of provisions at about 69° north latitude. The ship will then sail to Cape Stewart, the south-eastern extremity of Jameson Land, which, being low and slightly undulating, is well suited for winter quarters, besides having attractions for the mineralogist, and affording opportunities to the sportsman of obtaining abundance of fresh meat. When their equipment has been landed, most of the members of the expedition will go on board again, and spend the remainder of the arctic summer in exploring the fiords between Scoresby Sound and Franz Josef Fiord, after which the vessel will return home to Denmark. During the winter, scientific observations of all kinds will be taken, and, as soon as the young ice is strong enough, short journeys will be made in sleighs around the neighboring country. In the spring, longer excursions will be made up Scoresby Sound and to the inland ice. Where possible, the velocity of the glaciers will be measured, and other observations taken which may have a bearing on the numerous questions relating to the inland ice and glacial phenomena in general. At the end of June, having left the collections they may have made to be brought away by the ship, the explorers will take to the boats and follow the coast southwards. The steamer, after taking on board the collections at Cape Stewart, will make hydrographical observations to the north of Iceland and in Denmark Strait, until the time has arrived to seek the expedition at Angmagsalik. According to Capt. Holm and the statements of the Eskimo, the heavy masses of the polar ice lie, during the end of autumn, at some distance from the coast, and therefore September has been fixed as the month in which the expedition is to be taken on board. Should, however, the vessel be unable to reach the coast, or the expedition arrive too late in the season, the explorers will have to winter at Angmagsalik, and in the summer of 1893 make their way by boat to the Danish colonies on the West Coast, whence they can take a passage home in the ships of the Königl.-gronländischen Handel. A sum of 180,000 kroner (about $50,000) has been voted by the Danish Government for the equipment of the expedition.

SCIENCE:

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

REVIEW OF THE WORK OF THE "PILOT CHART."

WITH the December number the eighth year of this publication begins, the first number having appeared in December, 1883. The various changes and improvements that have been made in the chart since that time are strikingly shown by a comparison between a late copy and that first issued. The most conspicuous additions are the following: steam and sailing routes; region of equatorial rains; table of barometer normals and percentage of probable calms for each 5°-square; storm diagrams, with brief rules for action to avoid a hurricane; cautionary and storm signals in use along the Atlantic and Gulf coasts of the United States; the tracks, names, and dates of derelicts; list of dangerous obstructions to navigation along the coast, and of charts published and cancelled during the preceding month; regions of observed and predicted fog. Besides these additions and other less striking ones, the greater portion of the forecast meteorologic data has been thoroughly revised, and brought up to date; while the review is now prepared with very much greater accuracy and completeness, owing to the far greater number of observers who now send in regular reports to the United States Hydrographic Office, and the hearty approbation and support received from masters of vessels of every nationality.

During the last three years, especial efforts have been made to publish promptly, and make practically useful to navigators, the results of the many reports that are made, thus giving to each and every observer the benefit of the combined experience of hundreds of observers, and at the same time securing a wide and international circulation for data relating to the ocean. In this attempt two objects have been kept in view by the Hydrographic Office,—first, to give, in clear, practical form, as much late and important news as possible to navigators, and to aid them by every means in their power in lessening the dangers of the sea and increasing the safety and success of commerce; second, to attract the interest and attention of other classes of people to the life and duties of the officers and men of the navy and mercantile marine, and thus to insure a fair hearing and some attention and sympathy in any reasonable effort to improve the status and prospects of seafaring men and others directly interested in commerce. That these efforts have been successful to some extent, seems to be indicated by the support that their work has received from masters, owners, and agents, as well as from the public generally; and numerous quotations might be made from home and foreign reviews, and from public and private statements by recognized authorities, showing general recognition of the fact that this publication has achieved success in a new and untried field, and has been creditable to the United States. Not the least of the valuable results that have been achieved is the general recognition of the benefits to be derived from the use of oil in preventing heavy seas from breaking on board vessels,—a result universally attributed to the reports that have been published on the "Pilot Chart."

The subject of derelicts at sea, and the danger therefrom to commerce, has been emphasized in the same way; and some authorities are of the opinion that the recent marine conference owed its inception largely to the interest caused by the continued publication of such data.

A feature of the "Pilot Chart" that deserves special mention is the occasional publication of a supplement devoted to some subject of immediate importance. This plan was first tried in September, 1887; and since that time several supplements have been issued, each of which has attracted much favorable attention, and has been widely quoted. The following is a complete list of those published thus far:—

September, 1887, West Indian Hurricanes.—Diagrams and text explaining the circulation of the wind in a hurricane, with brief rules for action.

December, 1887, Transatlantic Steamship Routes for December.—The plan for steamer-routes recommended in order to avoid collisions, with a brief discussion of the winter storm-belt of the North Atlantic.

March, 1888, Water-Spouts off the Atlantic Coast of the United States during January and February, 1888.—Positions of water-spouts plotted on a small chart, with reports quoted in full, and a discussion of the subject.

August, 1888, Derelicts and Wreckage in the North Atlantic.—A history of the great log-raft, with a complete list of reports received from vessels that sighted the logs as they spread over the ocean, together with a graphic record of the drifts of the most notable derelicts.

February, 1889, The Derelict American Schooner "W. L. White."—An account of the transatlantic voyage of this notable derelict vessel, with all reports received, and a chart showing the track of the vessel and the general drift of Atlantic currents.

October, 1889, The St. Thomas-Hatteras Hurricane of Sept. 3–12, 1889.—Ten small charts, with accompanying text, illustrating the progress of this great hurricane from St. Thomas to our coast north of Hatteras, with a complete list of vessels from which reports were received in time for use in this connection.

During 1890 no supplements have been issued, but a large number of reprints in black and white have been made of the various diagrams and printed matter accompanying the chart. These have been widely circulated and republished, notably by the *New York Herald*, the *Boston Post*, and the *Liverpool Journal of Commerce*, to which papers the Hydrographic Office feel especially indebted for valuable assistance and support.

It is proposed to publish with the January chart a supplement devoted to the subject of ice in the North Atlantic during the season of 1889–90. This will contain charts showing the positions and dates of icebergs and field-ice reported during the past season (perhaps the most notable ice season on record), for which the data at

hand are very complete. Full credit will be given for every report received, and quotations will be published from reports containing information of special value.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

On the Geology of Quebec City.

THE researches of Sir William Logan, Mr. Billings, Dr. Sterry Hunt, Dr. Selwyn, Sir William Dawson, Professor James Hall, Professor Emmons, Professor Walcott, Professor Marcou, Dr. Ells, Professor Lapworth, and many others, on the geology of Quebec and its environs, have made that region classic ground to the student of North American geology. The famous Quebec group controversy, as well as its closely related friend the Taconic question in geology and the Lorraine-Hudson River problem, are all involved in the geologic history of Quebec. Much diversity of opinion has existed as to the exact geological position of some of the terranes at and about Quebec City, as also along the whole line of the great Appalachian or St. Lawrence-Champlain fault; and this is not at all astonishing, seeing that profound dislocations exist, intricate foldings of strata occur, and several terranes are met within an exceedingly small area, faulted and folded together in any thing but a simple manner, which require exceedingly detailed and careful examination before satisfactory conclusions are arrived at.

The rocks forming the citadel hill or promontory of Quebec (Cape Diamond) have been assigned to different positions in the geological scale by different writers and at different times. An elaborate review of their views is given in Dr. Ells' last report to Dr. Selwyn (1888), and published by the Geological Survey of Canada, which includes Dr. Bigsby's paper (1827), down to Professor Lapworth's report, etc., published in the "Transactions of the Royal Society of Canada" (1887). These Quebec rocks have been referred by some of the geologists above named to the age of the Quebec group (Levis division), while others, and the majority at present, regard them as newer than the Trenton limestone, viz., being of "Trenton-Utica," "Utica-Hudson," or "Lorraine" age. But before assigning a definite position to the rocks of Quebec City in the scale of terranes in America, it is necessary for the writer to state that so far he has been unable to find any evidence in the field, either stratigraphical or paleontological, whereby the Hudson River rocks and Lorraine shales as originally understood by Emmons could be correlated, and referred to the same or immediately following geologic terrane.

The fauna of the Norman's Kiln shales, that of the Marsouin, of the Tartigo River, Griffin Cove, and Gagnon's Beach rocks, as well as those from Crane Island, south-western point of the Island of Orleans, Quebec City, Etchemin Riviere (between St. Henry and St. Anselme), Drummondville, and other localities in Maine, Vermont, and New York States, form one large assemblage of forms peculiar to one terrane.

The fauna of the Lorraine shales (Cincinnati era) as characterized at Montmorency Falls, Cote Sauvageau, St. Charles Valley, Charlesbourg (near Church, two miles above St. Nicholas), Yamaska River, Riviere des Hurons, and in the undisturbed regions of Ontario (intermediate between the Utica terrane and the base of the Silurian (Upper) epoch), marks another terrane.

These two faunas, I hold, are very distinct, both in their paleontological and stratigraphical relations. The Lorraine terrane (see Dr. Selwyn's classification of formations in Canada, "Index to the Colours and Signs used by the Geological Survey of Canada") has a definite position; viz., at the summit of the Cambro-Silurian or Ordovician system. The strata at Quebec cannot be referred to the Lorraine terrane, nor to the Utica, nor yet to the Trenton or the Black River formation. Sir William Logan referred the Quebec City rocks to the Levis division of Quebec group; and yet the fauna which Mr. Weston and the writer have, along with Mr. Giroux and L'Abbe Laflamme, been able to obtain from the rocks of that locality, contains some forty or fifty species of fossils, including graptolites, brachiopods, ostracods, and trilobites, different from Levis forms, and yet capable of being correlated with forms from a portion of the Quebec group of Logan as described in his Newfoundland section, as also with Cambro-Silurian strata in the Beccaginmic valley of New Brunswick.

To give the precise geological horizon of the strata at Quebec City, I hold, is perhaps premature. They appear, however, to occupy a position in the Ordovician system higher than the Levis formation, being probably an upward extension of that peculiar series of sedimentary strata occurring along the present St. Lawrence valley, and which, owing to the peculiar conditions of deposition and specialized fauna entombed, Sir William Logan advisedly classed together under the term "Quebec group." This would make the rocks at Quebec about equivalent to the Chazy formation of the New York and Ontario divisions.

As to the propriety of retaining the term "Hudson River" group or terrane in geologic nomenclature at present, there may be some doubt. Much confusion exists as to its use. It would very naturally follow, however, that some such designation as the "Quebec terrane" or "Quebec formation" would be most acceptable at this particular juncture, and would include those rocks which constitute the citadel and main portion of Quebec City and other synchronous strata.

In a paper which the writer is now completing for the approaching meeting of the Geological Society of America next month, on the same subject, a more detailed and exhaustive demonstration will be made of the facts now in our possession, whereby to correlate many series of strata hitherto separated, and differentiate others which are by nature unlike. HENRY M. AMI.

Geological Survey of Canada, Ottawa, Nov. 28.

The Education of the Deaf.

POSITIVE evidence is all the world over regarded as of more value than negative testimony; and any one desirous may convince himself that congenital deaf-mutes can be taught to use spoken language correctly by articulation and by writing, without the intervention of any artificial signs, by a pilgrimage to the Institution for the Improved Instruction of Deaf-Mutes, corner of 67th Street and Lexington Avenue, this city; the Clark Institution for the Deaf at Northampton, Mass.; or the Day School for the Deaf, Boston, Mass. Any unbiased individual will come away from such a visit with the firm conviction that some teachers for the deaf have been for the last seventy years working great detriment to the elevation of an unfortunate class of our fellow-beings by preaching the fallacious and utterly untenable doctrine that such an education is an impossibility, and impracticable if possible. B. ENGELSMAN.

New York, Dec. 2.

BOOK-REVIEWS.

Are the Effects of Use and Disuse Inherited? An Examination of the View held by Spencer and Darwin. By WILLIAM PLATT BALL. London and New York, Macmillan. 8°.

THIS book is ultra-neo-Darwinistic. Natural selection has achieved every thing, according to the author: the effects of use and disuse are not inherited. "Innumerable modifications in accordance with altered use or disuse, such as the enlarged udders of cows and goats, and the diminished lungs and livers in highly bred animals that take little exercise, can be readily and fully explained as depending on selection. As the fittest for the natural or artificial requirements will be favored, natural or artificial selection may easily enlarge organs that are increasingly used, and economize in those that are less needed. I therefore see no necessity whatever for calling in the aid of use-inheritance, as Darwin does, to account for enlarged udders, or diminished lungs, or the thick arms and thin legs of canoe Indians, or the enlarged chests of mountaineers, or the diminished eyes of moles, or the lost feet of certain beetles, or the reduced wings of logger-headed ducks, or

the prehensile tails of monkeys, or the displaced eyes of soles, or the altered number of teeth in plaice, or the increased fertility of domesticated animals, or the shortened legs and snouts of pigs, or the shortened intestines of tame rabbits, or the lengthened intestines of domestic cats" (pp. 82, 83).

Again: "The inferiority of Europeans, in comparison with savages, in eyesight and in the other senses, is attributed to 'the accumulated and transmitted effect of lessened use during many generations.' But why may we not attribute it to the slackened and diverted action of the natural selection which keeps the senses so keen in some savage races?" (p. 85).

These examples are sufficient to show what standpoint the author takes.

Higher Education of Women in Europe. By HELENE LANGE, Berlin. Tr. by L. R. Klemm. New York, Appleton 12°. $1.25.

WOMEN in Germany, as our readers probably know, are practically excluded from the higher education, and are sparingly employed as teachers even in girls' schools, Germany being in this respect far behind England and America. It is not surprising, therefore, that a book like this should appear from a German woman, pleading the cause of her countrywomen with earnestness and love. It is, moreover, a work of real ability, showing not only a clear conception of what is wanted, but also an equally clear comprehension of the difficulties in the way. The book opens with an account of the provisions recently made for woman's higher education in England, of which the authoress speaks with much enthusiasm. She then touches lightly on women's schools in other European countries, and shows, that, of all nations claiming to be civilized, Germany has done the least for the higher education of its women. In short, no provision whatever is made for it, so that "the German women have to go to foreign countries if they will not forego a higher education."

The argument for giving women access to a university training is based in the main on these two considerations,—that many women need it in order to gain a living by professional work, and that women whose circumstances raise them above want need the means of developing their higher natures, thus enabling them to be more useful in the position they hold. These arguments and others that the authoress uses are familiar to Americans, and it is surprising and almost disgusting to read of the bitter, and we must say unmanly, opposition to women's education that is shown by the men of Germany. It is based on the same considerations that were formerly adduced in England and America, with the addition of the sordid plea, that, if women are admitted to the higher education, men will suffer from their competition in the professions. These arguments are all set aside by the able and temperate discussion in this book, which all persons interested in the subject will like to read. Nothing is said in the original work about women's education in America; but the translator's introduction contains some statistics and other matter relating to the subject, showing how rapid has been its progress in recent years.

Longmans' School Geography for North America. By G. G. CHISHOLM and C. H. LEETE. New York, Longmans, Green, & Co. 12°. $1.25.

Handbook of Commercial Geography. By G. G. CHISHOLM. New York, Longmans, Green, & Co. 8°.

A Smaller Commercial Geography. By G. G. CHISHOLM. New York, Longmans, Green, & Co. 12°. 90 cents.

THE well-known London publishing-house of Longmans Green, & Co. have recently brought out several books on geography to which our particular attention is called. Thornton's "Physiographies" have already been mentioned in our columns. Chisholm's "Geographies" are now before us First comes a general work, entitled "Longmans' School Geography for North America," made over for use in this country from an English edition by Leete. Its pecular features are, first, the octavo form, from which all maps are omitted, these to be supplied later in "Longmans' new Atlas," an American edition being now in preparation; second, the omission of special accounts of our various States, the whole country being first described in general as to its physical features, and then reviewed by districts with much critical perception of significant geographical details. A good deal of repetition from State to State is thus saved, and the use of such a book might have a real political significance in impressing the essential unity of the country on the minds of the scholars. It may also be said that the explanation of the causes that have led to the locations of cities constitutes a feature of the book, and in many cases an interesting one. The physical introduction in the first sixty pages is not so satisfactory as the rest of the book, being too crowded, and lacking home illustration, this part having no appearance of special adaptation to our schools. The illustrations are generally taken from photographs, and are well selected; but some are not as fresh and sharp-cut as we could wish. The author rightly lays emphasis on the omission of all questions at the end of chapters, and on the avoidance of the paragraph style, which so often results in memorizing instead of in learning. Considering the excellence of our own school geographies, it is a somewhat hazardous experiment for a foreign house to compete with our publishers, and we shall watch with interest to see how far this one of its products finds favor here.

Chisholm has also prepared a "Handbook of Commercial Geography" and a "Smaller Commercial Geography." These are written for English readers without re-editing for this country; but they deserve a welcome from those of our teachers who have the skill to lead their scholars to read outside of their regular text-books. In the present crowded condition of the studies of all our common schools, it is difficult to imagine where time could be found for commercial geography, unless as side-reading; and for this purpose either of the above books may be highly recommended for school libraries. Commercial and business colleges might use them to great advantage as regular text-books. The introductory chapter on commodities and the circumstances which affect their production and carriage will certainly hold the attention of young people, to whom geography has been presented as a live study. The rest of the books is more statistical than is compatible with attractive interest, but it would be a valuable aid in answering the questions that properly taught scholars must often ask.

Warren's New Physical Geography. By W. H. BREWER. Philadelphia, Cowperthwait. f°.

A NEW edition of "Warren's Physical Geography" has been prepared by Professor W. H. Brewer of Yale University. It retains the atlas form so generally used for books of this class, and divides its chapters into short paragraphs directly prepared for the scholars' use, and followed by questions for the teacher. The chief divisions of the book are, the earth as a planet, chemical and geological history of the earth, the land, the water, the atmosphere, organic life, and the United States. The illustrations are generally good, although a greater number of designs appear than is desirable in these days of photographs. The double-page Mercator charts are distinctly printed and colored, showing the conventional series of facts, volcanoes and earthquakes, heights of land and depths of sea, drainage and winds, ocean currents, rainfall, and annual isotherms. The imitation bas-reliefs of the continents are clearly printed, and give only too emphatic an idea of the mountain ranges. The statements of the text are evidently carefully considered, and brought down to date; and we believe that the book as a whole must give satisfaction to those who are satisfied to use any book on physical geography now in existence.

The questions that a review of this work raises do not refer particularly to the book itself, but to its class. If we bear in mind the general quality of the scholars who are to use it, and their easy contentment with facts presented in a direct manner, and also consider the busy life of the teachers, who have no time, or at best very little, to give to the personal teaching that idealists in education desire, then the book must be regarded as satisfactory; but if we consider the intellectual growth of the scholar, and his individual development and training, it may be doubted if any book of this kind can be regarded with approval, because of the necessarily great condensation in the treatment of its varied subjects. Professor Brewer has skilfully avoided as much of this difficulty as any one could; his paragraphs are unusually clear, although

there is occasionally a lapse in this respect; and his statements are manifestly made only after much study and preparation, for it is seldom that there is any reason for criticism on the ground of inaccuracy. It is hardly to be expected that any general text book shall be free from slips of one kind or another, and the agents of rival publishing-houses will always have their opportunity of picking up little flaws and magnifying them before school superintendents. We do not intend to aid these agents by mentioning any little errors here discovered; but it is allowable to wonder why this and all other text-books fail to explain difference of latitude as the angle between the horizons at two places on a meridian, why they always fail in explaining the low atmospheric pressure around the poles, why they speak of mountains and valleys as the "eventual" forms to which erosion will reduce the land.

The publishers call particular attention to the revision of the chapter on the atmosphere; and it certainly deserves commendation. A very rational understanding of the phenomena on which climate and weather depend may be gained from it; and this is much more than could be said of the older books. The chief omission here is one that prevails through the whole book,— the absence of any indication or suggestion that the scholar can find out many of these things for himself. A physical geography in which this idea was the main theme would be welcomed by many teachers.

The Life of John Ericsson. By WILLIAM CONANT CHURCH. Vols. I. and II. New York, Scribner. 8°. $6.

THE author has presented this work on the life of the great inventor in a clear, readable manner, and has shown excellent judgment and a remarkable insight into the character and scientific attainments of John Ericsson.

There is one fact that must impress itself upon those who read these volumes; and that is, that in the life's work of the man one can trace step by step the development of the steam-engine, almost from its very beginning, to these days when its power is felt all over the world. Even the matter of forced draught, which is one of the vexed questions of the day, we find was considered in his early plans for steam machinery. Naval construction and naval warfare were revolutionized by the introduction of the screw propeller, which the author shows beyond question to have been due to the genius of Ericsson, from whose engines, introduced almost half a century ago, have gradually grown the magnificent machinery which moves immense hulls about the ocean at a rate of speed that fully bears out prognostications made years before others could realize that they were any thing more than the dreams of an enthusiast Of all Ericsson's inventions, the one most closely connected with his memory in the minds of Americans will always be the "Monitor." The idea of this war-vessel appealed at once to the minds of the naval authorities, whose prompt and spirited action was followed by a great display of energy on the part of the builders; so that, "while the clerks of the department were engaged in drawing up the formal contract, the iron which now forms the keel-plate of the 'Monitor' was drawn through the rolling-mill." It has been estimated that the new vessel contained at least forty patentable contrivances; and Ericsson was again and again urged to secure patents for these, but without avail. "He was strangely neglectful all through life of this means of protecting his property rights. Numerous as were his patents, they by no means represented the full measure of his ingenuity, and many of them were taken out to secure for himself, as well as for others, the right to use his own inventions." It was Ericsson's habit to wait until he was ready to present his engineering conceptions in practical form before announcing them. Thus they had opportunity to ripen in his mind, and to gain in clearness and completeness with growing experience. The conception of the "Monitor" as part of his mental history was nearly half a century old when it was put into execution to meet the exigencies of war.

In demonstrating the efficiency of his method of under-water torpedo attack, he said, "My only object is that of seeing the sea declared by all nations as sacred neutral ground. It is the highway of mankind" He also declared the art of war to be in its infancy. "When perfected, man will be forced to live in peace with man. This glorious result, which has been the cherished dream of my life, will unquestionably be attained before the close of the present century."

Aside from his contributions to the practical part of warfare, which, collateral and incidental, were many, and are to-day showing how far from being visionary and impracticable he was, Ericsson went deeply into the scientific questions bearing upon radiant energy, thermo-dynamics, light, and heat. His various devices for a caloric engine occupied a great deal of his attention throughout his professional career, and its development was naturally associated with inquiries as to the nature of solar energy, and the possibility of its direct application to the purposes of human industry. He resolved, as he said, to measure for himself "the intensity of that big fire which is hot enough to work engines at a distance of 90,000,000 miles." Toward the close of his life, in writing to a friend, he says, "The sun-motor is nearer perfection than the steam-engine; but until the coal-mines are exhausted its value will not be fully acknowledged." As the present study of solar physics dates from only thirty years ago, Ericsson is one of the pioneers in this field so fruitful in its promise of great revelations, and "he is certain to be remembered as one who did much to stimulate and direct inquiry in this most important field of physical research."

Of his friendships his biographer says, "He was as true to his friends as he was charitable and forgiving toward those who had done him injustice or positive wrong. He was full of kindly feeling, and was always ready to stretch forth his hand to those in need of his service." He was utterly unostentatious in his many charities; and what he did was done with his whole heart, and he added to the gift the grace of cheerful giving. Col. Church thinks that "whatever the final determination as to the correctness of some of Ericsson's conclusions, it cannot be questioned that he has made very important contributions to science." The work is an undoubted addition to literature, is rendered attractive by numerous and well selected illustrations, and contains an index of great completeness.

AMONG THE PUBLISHERS.

LAST spring appeared a little volume entitled "An Appeal to Pharaoh: a Radical Solution of the Negro Problem." The steadily growing demand has determined the publishers (Fords, Howard, & Hulbert of New York) to issue an edition in paper covers, and to announce the name of the author, who is Mr. Carlyle McKinley, an editorial writer on the *Charleston* (S.C.) *News and Courier.*

—Mr. Daniel Greenleaf Thompson has written an elaborate essay on "The Philosophy of Fiction in Literature," in which the principles of the novelist's art are examined in detail, while especial attention is paid to the consideration of the moral aspects of the novel, and of its influence for good or evil. The book will be published shortly by Longmans, Green, & Co.

— The Pacific district comprises California, Oregon, Washington, and Nevada; but in "Land Birds of the Pacific District," by Lyman Belding (San Francisco, California Academy of Sciences), the district of British Columbia, and the notes of the lighthouse-keepers on the coast of British Columbia and Washington, are included. "This report aims mainly to show the arrivals and departures of migrating species, as well as to give a catalogue of all the species known to occur in the district." The number of species recorded is 295. It is an important contribution to the geographical distribution of the land-birds of the Pacific coast.

— The fourth volume of "The Century Dictionary" has just been issued, containing the letters *M* to *P* inclusive, and forming a quarto of 1,323 pages, illustrated by nearly 1,500 cuts. The first volume was issued in October, 1889; the fourth has followed in November, 1890 (almost within a year); and the other two volumes, completing the work, will be published during 1891,— the first early in the year, and the second probably by summer. The present volume is the largest of the series yet published. With

each successive instalment of the dictionary it has become more and more clear that the original estimates were too small, both as regards the total of pages in the completed book and the wealth of words and other lexicographical material which it would contain. The number 6,500, which was announced as the limit for the pages, must be increased to at least 7,000, and the number of words defined will be considerably in excess of the 200,000 at first promised: for the words contained in the first four volumes now published (two-thirds of the work, 4,880 pages) are in round numbers 152,000; and, if we may suppose that the same fulness will characterize the letters remaining to be treated, the total cannot fall far short of 225,000. An examination of the vocabulary of "The Century Dictionary" will show that only those words, derivatives, and compounds are admitted which have an established place in the language or require definition. Had the editors not been conservative in this particular, their list would doubtless have been increased to 250,000 words. The fourth volume illustrates the technical and scientific character of the dictionary. Beginning with the letter *M*, one meets the prefix *macro-*, followed in quick succession by *meso-*, *meta-*, *micro-*, *mono-*, and many others of greater or less importance, from which are formed groups of hundreds of technical terms, most of which have come into existence during the last ten or fifteen years. The same is true of the other letters, especially of *P*, which, indeed, owes its size (660 pages) very largely to this wealth of scientific material. The treatment of technical words, too, is on a broad scale in this volume, as is well illustrated by the definitions of *magnesia*, *magnet* (and its derivatives), *mammalia*, *man* (in its etymology), *marble*, *metamorphism*, *meter*, *microscope*, *mirror*, *mode* (in its musical sense), *muscle*, *nervation*, *operation*, *opening* (in chess), *orchestra*, *Orchideæ*, *pianoforte*, etc. The same fulness marks the definitions of common names of animals and plants, as of *mackerel*, *mildew*, *minnow*, *partridge*, *pine*, etc. "The Century Dictionary" is first a dictionary of the English language, and after that an encyclopedic dictionary. Take, for example, the common English word *put*. It occupies seven columns of the dictionary, and its treatment includes 17 definitions and 169 special phrases, which are illustrated by 190 quotations ranging from the earliest period of English literature to the present day, the definitions and quotations together exhibiting the word in every important phase of its idiomatic use. This treatment of *put*, liberal as it is, is in no sense encyclopedic, but is strictly lexicographic, being necessitated by an attempt really and thoroughly to define the word. It simply shows what an amount of information about common words the editors of "The Century Dictionary" are bringing to light. The facts thus exhibited by the word *put* are perhaps even more strikingly shown by *make*, with 83 definitions, 159 phrases, and 126 quotations, and by *pass*, with 72 definitions, 30 phrases, and 127 quotations. These, of course, are among the most striking instances of the kind; but what is true of them is true on a smaller scale of the treatment of nearly every common word in the volume. The book abounds not only with fresh discussions of old words, and new definitions of familiar words illustrated by apt quotations, but also with words which have been in the literature of the language for perhaps scores of years, but which are new in the sense that no dictionary has before recorded them. There are many illustrations of special interest in this fourth volume.

— A seasonable subject is discussed by Dr. William H. Flint in his article on "Children's Coughs," in the December number of *Babyhood*. The writer divides all coughs into harmless and serious ones, and gives many hints which will enable mothers to distinguish one class from the other. Dr. Yale, the medical editor, furnishes an article on "What may be done to prevent Diphtheria."

—In the second volume of the Science in Plain Language Series, William Durham of the Royal Society of Edinburgh writes interestingly on the general subject of astronomy, describing in

Publications received at Editor's Office, Nov. 10–22.

SCUDDER, H. E. Fables and Folk Stories. Part I. Boston and New York, Houghton, Mifflin, & Co. 96 p. 16°. 15 cents.
SIME, J. Geography of Europe. London and New York, Macmillan. 341 p. 16°. 80 cents.
SOCIOLOGY. Popular Lectures and Discussions before the Brooklyn Ethical Association. Boston, J. H. West. 403 p. 12°. $2.
U. S. GEOLOGICAL SURVEY. Topographical Maps of Portions of Massachusetts, New Hampshire, Vermont, Montana, New York, Virginia, Maryland, California, Arkansas, Indian Territory, New Mexico, Missouri, Georgia, Texas, Illinois, North Carolina, Iowa, Pennsylvania, Alabama, New Jersey, West Virginia, Rhode Island, Maine, Colorado, Wisconsin, Kansas, and Connecticut. Washington, Government, 1890. 62 maps, 42 by 50.5 cm.
WOODWARD, C. M. Manual Training in Education. New York, Scribner & Welford. 310 p. 12°. $1.25.

plain language some of the principal facts and speculations connected with that science. The plan of the work is similar to that which proved so successful in the first volume of the series, in which the same author treated of evolution and kindred subjects. In separate articles, each complete in itself yet closely connected to the others, the author deals successively with the sun and moon, the earth, the stars and nebulæ, and the planets; adding some speculations on the formation of the heavenly bodies and the contents of space, and concluding with a brief chapter on the tides, light, and the spectroscope. This series of handy volumes is published by Black of Edinburgh, and in this country by Macmillan.

— Mr. Nicholas P. Gilman, author of "Profit-Sharing between Employer and Employee," has in preparation a new volume, to be entitled "Socialism and the American Spirit." It will comprise chapters on the re-action against individualism; recent American socialism; the American social idea in practice as distinguished from individualism and socialism; the field for social reform in America; arbitration, industrial partnership, and co-operative production, considered as steps out of labor troubles; recent progress in profit-sharing; the first duty of the educated classes; the way to Utopia; etc.

— Messrs. Henry Holt & Co. will publish in January the first number of a new monthly, *Educational Review*, of which Professor Nicholas Murray Butler of Columbia, who is president of the New York College for the Training of Teachers, will be editor-in-chief: and associated with him will be Dr. E. H. Cook, head master of Rutgers Preparatory School, New Brunswick, N.J.; Dr. William H. Maxwell, superintendent of schools in Brooklyn; and Dr. A. B. Poland, superintendent of schools in Jersey City. This gives the university, the preparatory school, and the public school representatives on the editorial board. The character of the publication may be further inferred from the fact that the circular announcing it contains the indorsements of the presidents of Harvard, Yale, Johns Hopkins, Columbia, Massachusetts Institute of Technology, Cornell, University of Michigan, and some hundred educators of corresponding prominence. Probably no equally promising attempt at an educational periodical has ever before been made in America, if anywhere.

— The J. G. Cupples Company of Boston will soon issue a holiday book entitled "Aunty's Elfin Land." It is a collection of fairy-stories, or, rather, the combined histories of three children who had most strange adventures in the land of "the little folk." They are written by Mrs. Maria Hildreth Parker, and are illustrated by Hermann D. Murphy.

— In the December number of the *Magazine of American History* the opening paper is an historical sketch of the rise and fall and characteristics of the ancient town of Fort Benton, in Montana, with illustrated accounts of early navigation of the upper Missouri River. The second contribution is "David Hartley and the American Colonies," by Joseph W. Hartley of New York. A portrait of David Hartley, England's signer of the definitive treaty of peace with America, forms the frontispiece to the magazine. Following these articles are "The Institution of Thanksgiving Day, 1623," by Jacob Harris Patton, A.M.; "La Salle's Homestead at Lachine," by John Fraser of Montreal; "A Typical Old-Time Minister, the Reverend Benjamin Tappan," by Rev. D. F. Lamson; "Glimpses of Early Michigan Life in and about Kalamazoo," by Mary V. Gibbs; "Our Old Webster's Spelling-Book," by Rev. A. M. Colton; and "Some Literary Statesmen," which brings into view facts in relation to eminent writers in the councils of the nation, by Milton T. Adkins. Shorter articles are "President Garfield's Silent Journey," "Mrs. Elizabeth B. Custer surrounded by Buffaloes, or Camp Life in Kansas Twenty Years Ago," "A Cluster of Christmas Poems for the Household," and some hitherto unpublished letters.

CALENDAR OF SOCIETIES.

Biological Society, Washington.

Nov. 30.—T. H. Bean, The Death of Salmon after Spawning; Theobald Smith, On Species among Bacteria; G. B. Sudworth, Notes on Nomenclature; F. A. Lucas, The Wing of Metopidius.

Boston Society of Natural History.

Dec. 3.—J. Walter Fewkes, The Summer Ceremonials of the Zuñi Indians: a Study of Aboriginal Religion (illustrated by the stereopticon).

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—An Exploring Expedition, backed by $15,000, will be sent into Alaska and the British Northwest Territory the coming year, to be gone one or two seasons. A scientist or two will more than likely be taken along. Applications from such will be gladly received and carefully considered. To assist in making these applications the commander would say that he considers a full practical knowledge of mineralogy and geology necessary, and if the applicant can add the duties of botanist, ethnologist, or any other of the sciences, and photography, sketching, medicine and surgery, or other useful arts for exploring, it will add to the chances of being selected. Applicants must be physically perfect, and ought to be about medium age. One of these scientists will be the second in command of the party. Any credentials forwarded for consideration will be returned, if requested, after consideration. Address "ALASKA," care of *Science*.

WANTED.—There being a considerable annual income for the purchase of books for the Museum Reference Library of Iowa College, it is desirable to have at hand any and all circulars, specimen sheets, catalogues, etc., of all works on Natural History in general, both foreign and domestic. Circulars of museum supplies, apparatus, etc., etc., desired also. State terms. Address ERWIN H. BARBOUR, Box 1333, Grinnell, Iowa.

WANTED.—A situation as Analytical Chemist is desired by the assistant of the late noted scientist, Dr. Cook, during his 15 years survey of the State of New Jersey Highest testimonials furnished. Address Prof. EDWIN H. BOGARDUS, New Brunswick, P. O. Box 224, care Prof. F. C. Van Dyck.

COULD some one inform me what the ingredients and origin of asphalt as used for street-paving and gathered at Trinidad are? Also how gathered and shipped by natives, and mode of refining by the Warren-Scharf Co. of New York and the Barber Co. of Washington? G. KNIPER, 28 Gunn Block, Grand Rapids, Mich.

WANTED.—A position in a Normal School or College as teacher of Botany, Physiology, Zoölogy, Embryology, Chemistry, Physics, or German, by a university graduate who has done special work in the above lines. Several years' experience in teaching, and one year as assistant in Biology in a prominent university. Box 396, Greencastle, Ind.

PROFESSOR W. M. DAVIS, Harvard College, Cambridge, Mass., desires to correspond with professional and amateur photographers, from whom he can obtain views of New England landscapes.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I wish to exchange Eastern *Lepidoptera* for those that I do not have, particularly those found in the South. Jos. F. Crandall, Honesdale, Wayne Co., Pa.

To exchange, 1890 Seeger and Guernsey Cyclopedia, containing a complete list of the manufactures and products of the U. S., and address of first hands, cost $6. David R. Lewis, Saybrook, Ill.

For exchange—Nice specimens of Unios alatus, trigonus, parvus, occidens, anadontoides gibbosus, rectus, verucosus, gracilis coccineus, ventricasus, multiplicatus and plicatus cornutus. Margaritana confrogosa, complanata, rugosa. Anadonta edentula, decora, corpulenta, and about 300 of the beautiful Ana suborbiculata. Wanted: Unios from all parts of the world, and sea-shells. Address Dr. W. S. Strode, Bernadotte, Ill.


Halsead Architect's Union, Phila. Pa.

SCIENCE

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COAST SURVEY PARTIES IN ALASKA.

THE United States Coast and Geodetic Survey Office has received a telegram from their sub-office in San Francisco, Cal., giving the information that an agent of the Alaska Commercial Company had arrived by the last steamer from St. Paul, Alaska, bringing mail from the Coast and Geodetic Survey parties who have been engaged in making explorations and surveys on and near the 141st meridian of longitude (the boundary between Alaska and the British possessions). These two parties were commanded by Messrs. J. E. McGrath and J. H. Turner, assistants of the Coast and Geodetic Survey. The party under Mr. McGrath ascended the Yukon River to the boundary-line, and there made its headquarters, while that headed by Mr. Turner went up the Porcupine River to the Rampart House (the Hudson Bay Company's trading-post in the vicinity of the boundary), and there camped for the further prosecution of their work. Both parties were at their posts early in the autumn of 1889; and with the provisions which they carried with them, and those which were to be forwarded by the Alaska Commercial Company's steamer, they would have been provided with an ample quantity for fully fifteen months: but the loss of the steamer "Arctic" in 1889, and with it a portion of the provisions on which they relied, did not leave much margin for "high living" in Mr. McGrath's party; but, as he states, "we might have had to test the virtue of a very spare diet only for two unexpected resources that turned up. The first was a great crop of turnips that Mr. McQuesten, agent of the Alaska Commercial Company, raised at the store on Forty-Mile Creek during the summer: it was the first time he had made a garden there. The second was a greater number of deer crossing the trails they have between the Tan′-a-nah′ and the Yukon Rivers (these trails intersect the valley of Forty-Mile Creek) than was ever before known by white men, and a corresponding abundance of fresh meat."

Mr. McGrath's party, however, remained at their post, and accomplished all the work which a very stormy, although not as cold as had been expected, season permitted.

The records made comprise a set of magnetic and of meteorological observations for a year; a set of specimens of sediments obtained from filtering certain measured quantities of the water of the Yukon River, made at regular intervals; certain botanical specimens; and a series of photographs. Mr. McGrath also gathered considerable information from some of the most intelligent of the Indians which he encountered at Forty-Mile Trading-Post, and had them make for him lists of all the Indians from Fort Yukon to Big Lake on the White River, and from the Tan′-a-nah′ to the tributaries of the Porcupine. These were drawn up in tallies, and arranged according to families. These he turned over to Mr. Greenfield (one of Mr. Petroff's deputies); and, as some of the tribes had not been reached by Mr. Greenfield, it was of much service to him in making the census enumeration.

Owing to the stormy weather, Mr. McGrath was unable to obtain a sufficient number of astronomical observations to justify him in returning this fall; and his party will therefore remain until next spring, and then descend the river, doing what work they can in the cause of science on their way down.

Mr. Turner's party were much more favored by the weather than the other party. They completed the necessary astronomical observations for the determination of the geographical position of their station on the Porcupine River at the boundary-line, also a set of magnetic and meteorological observations, and made a topographic map (on a scale of 1:5000) of the river in the vicinity of their camp, and a survey (on a scale of 1:200000) from the boundary to Fort Yukon, a distance of about one hundred miles.

A small scheme of triangulation was undertaken to locate three monuments placed to mark the boundary-line. An exploring expedition was sent during the months of March and April to explore the line northward to the Arctic Ocean. The party visited Herschel Island. During May another trip was made about forty miles to the southward, as far as Salmon Trout River.

Mr. Turner reports that the Hudson Bay Company have this summer moved their quarters to a site within the British domain.

Mr. Turner reached St. Michael's Aug. 30, 1890, with his party, too late to catch the steamer coming south. The party will winter there, and in the spring carry the triangulation toward the mouth of the Yukon River, until relieved by orders from the Coast and Geodetic Survey Office.

Both gentlemen speak in their reports of the uniform and untiring zeal which has been displayed by the officers and men in their parties; and, from this standpoint, it seems as if the subordinates have only tried to emulate their chiefs.

THE LATEST RESULTS OF ORIENTAL ARCHÆOLOGY.[1]

A YEAR ago (*Science*, Dec. 13, 1889) I gave a short account of the startling archæological discoveries which had just been made in Arabia. The explorations of Doughty, Euting, Huber, and, above all, Glaser, the inscriptions they had found, and the historical facts disclosed by the decipherment of the epigraphic material, have thrown a sudden and unexpected flood of light on a continent which has hitherto been darker even than Central Africa. The members of the last Oriental Congress heard with astonishment that a country

[1] Fr m The Contemporary Review.

which had been supposed to be little more than a waste of sand and rock, inhabited by wandering nomads, and first appearing on the page of history in the time of Mohammed, had really been a centre of light and culture in remote ages, — a land of active trade and commerce, which once exercised an important influence on the civilized world of the ancient East, and possessed an alphabetic system of writing earlier, it would seem, than that which we know as the Phœnician alphabet.

I was able to give only a brief outline of the results that had been announced by scholars in the new field of research. A large portion of the inscriptions on which they were based had not been published, and the work promised by Dr. Glaser, on the ancient geography of Arabia, had not appeared.[1] Moreover, there had not yet been time for the special students of Arabian history and epigraphy to criticise the conclusions at which scholars like Professor D. H. Müller or Dr. Glaser had arrived.[2]

A year has passed, and we have now had time to take a sober review of the new discoveries, and examine their weak points. In one respect the history of ancient Arabia which I laid before the readers of the *Contemporary Review* must be modified. Professor D. H. Müller was too hasty in ascribing an early date to the inscriptions of Lihhyân in northern Arabia. Instead of belonging to the tenth, or even the seventh, century before our era, it is now evident that they are not earlier than the fall of the Roman Empire. They are strongly influenced by the religious ideas and technical terms of Judaism, and belong to the period when Jewish colonies and Jewish proselytism were rapidly extending through Arabia. The kingdom of Lihhyân rose and decayed at no long interval of time before the birth of Mohammed.

On the other hand, further study has gone to confirm Dr. Glaser's view of the great antiquity of the Minæan kingdom, and of the spread of its power from the south of Arabia to the frontiers of Egypt and Palestine. There can be no doubt that it preceded the rise of the kingdom of Saba, the Sheba of the Old Testament. There was no room for the contemporaneous existence of the two monarchies. Geographically they covered the same area; and the cities of Saba were embedded, as it were, within the territory of Ma'in. But the Sabæan cities flourished at the expense of those of Ma'in, and later tradition forgot even the names of the old Minæan towns.

The kingdom of Saba was already flourishing when Tiglath-Pileser and Sargon ruled over Assyria, in the eighth century B.C. And not only was it flourishing: its power had extended far to the north, where the Assyrian monarchs came into contact with its king. The visit of the Queen of Sheba to Solomon carries back the foundation of the Sabæan monarchy to a still earlier date. Unless we are to suppose that the visit is the invention of a later writer, we must conclude that nearly ten centuries before the Christian era Saba had already superseded Ma'in; and that the old kingdom, with its trade and culture, its fortified cities and inscribed walls, had already passed away. The fact would explain why it is that classical writers know only of a Minæan people, not of a Minæan kingdom; and that even in the pages of the Old Testament, while references occur to Sheba, only a careful search can detect the name of Ma'in.

[1] Dr. Glaser's large and learned volume on the ancient geography of Arabia has now been published (Skizze der Geschichte und Geographie Arabiens, vol. ii., Berlin, Weidmann), and contains a wealth of information on subjects like the site of Ophir, or the geographical knowledge of Ptolemy.

[2] Skizze der Geschichte Arabiens, Part I. (Munich, Straub).

Dr. Glaser has shown that the "kings" of Saba were preceded by the Makârib, or "high priests" of Saba. Here, as in other parts of the Semitic world, the priest-king was the predecessor of the merely secular king. The State was originally regarded as a theocracy, and it was some time before the priest and the king became separated from one another. We are reminded of the history of Israel, as well as of Jethro, the "priest of Midian." As in Assyria, where there were "high priests of Assur" before there were "kings of Assyria," the State was represented by a deity whose name it bore, or who derived his name from the State. Saba, like Assur, must once have been a god.

We are already acquainted with the names of thirty-three Minæan sovereigns. Three of them have been found by Professor Müller in inscriptions from the neighborhood of Teima, the Tema of the Old Testament, in northern Arabia, on the road to Damascus and Sinai. Their authority, therefore, was not confined to the original seat of Minæan power in the south, but was felt throughout the length of the Arabian peninsula. The fact is confirmed by an interesting inscription copied by Halévy in southern Arabia, which has been deciphered by Professor Hommel and Dr. Glaser. It tells us that it was engraved by its authors in gratitude for their rescue by Athtar and other deities "from the war which took place between the ruler of the land of the south and the ruler of the land of the north," as well as "from the midst of Egypt (*Mitsr*) in the conflict which took place between Madhi and Egypt," and for their safe restoration to their own city of Qarnu. The authors of the inscription, Ammi-tsadiq and Sa'd, further state that they lived under the Minæan king, Abi-yada' Yathi', and that they were "the two governors of Tsar and Ashur and the farther bank of the river."

Professor Hommel has pointed out that in Ashur we have an explanation of the Asshurim of the Bible, who are called the sons of Dedan (Gen. xxv. 3, 18); while Tsar must be a fortress often mentioned on the Egyptian monuments as guarding the approach to Egypt, on what would now be the Arabian side of the Suez Canal. Madhi Dr. Glaser would identify with Mizzah the grandson of Esau (Gen. xxxvi. 17), but the other references in the inscription are obscure. It proves, however, that the power of the Minæan princes was acknowledged as far as the borders of Egypt, in what Professor Hommel believes to have been the age of the Hyksos. That their authority was recognized in Edom is shown by an inscription in which mention is made of Gaza.

It would thus appear that Palestine, or at all events the tribes immediately surrounding it, were in close contact with a civilized power which had established trade-routes from the south, and protected them from the attacks of the nomad Bedouin. The part now performed, or supposed to be performed, by Turkey, was performed before the days of Solomon by the princes and merchants of Ma'in. A conclusion of unexpected interest follows this discovery. The Minæans were a literary people: they used an alphabetic system of writing, and set up their inscriptions, not only in their southern homes, but also in their colonies in the north. If their records really mount back to the age now claimed for them, — and it is difficult to see where counter-arguments are to come from, — they will be far older than the oldest known inscription in Phœnician letters. Instead of deriving the Minæan alphabet from the Phœnician, we must derive the Phœnician alphabet from the Minæan, or from one of the Arabian alphabets of which the Minæan was the mother; in-

stead of seeking in Phœnicia the primitive home of the alphabets of our modern world, we shall have to look for it in Arabia. Canon Isaac Taylor, in his "History of the Alphabet," had already found himself compelled by palæographic evidence to assign a much earlier date to the alphabet of South Arabia than that which had previously been ascribed to it, and the discoveries of Glaser and Hommel show that he was right.

As soon as we reverse the problem, and assume that the Phœnician alphabet is later instead of earlier than the Minæan, we obtain an explanation of much that has hitherto been puzzling. The names given to many of the Phœnician letters are at last found to agree with the forms of the latter. It is only in the South Arabian alphabets, for instance, that the letter called *pê* ("the mouth"), our *P*, has the form of a mouth, or that the first letter, *aleph* ("an ox"), really resembles the head of that animal. Moreover, we can now understand how it is that the South Arabian alphabets possess letters which do not occur in the Phœnician alphabet, and are not derived from any of the Phœnician characters. The Phœnician language had lost certain sounds which comparative philology has shown belonged to the Semitic parent-speech, and which were preserved in the languages of Arabia. That these sounds should have been represented by special symbols in the Arabian alphabets, if the latter had been borrowed from the defective alphabet of Phœnicia, is unintelligible: in such a case the symbols would have been modifications of other symbols already existing in the alphabet, or else the same symbol would have been allowed to express more than one sound. This has actually happened in Hebrew, where the same symbols stand respectively for *'ain* and *ghain*, for *s* and *sh*. There can be but one explanation of the fact that the Arabian alphabets denote by independent symbols certain sounds which had been lost in Phœnician pronunciation. The Arabian alphabets are more primitive than the alphabet of Phœnicia. When the latter first comes before us, it is in a comparatively late and conventionalized form, widely removed from the hieratic characters of Egypt, out of which it is commonly supposed to have been developed.

The discovery of the antiquity of writing among the populations of Arabia cannot fail to influence the views that have been current of late years in regard to the earlier history of the Old Testament. We have hitherto taken it for granted that the tribes to whom the Israelites were related were illiterate nomads, and that in Midian or Edom the invaders of Palestine would have had no opportunity of making acquaintance with books and written records. Before the time of Samuel and David it has been strenuously maintained that letters were unknown in Israel; but such assumptions must now be considerably modified. The ancient Oriental world, even in northern Arabia, was a far more literary one than we have been accustomed to imagine; and as for Canaan, the country in which the Israelites settled, fought, and intermarried, we now have evidence that education was carried in it to a surprisingly high point. In the principal cities of Palestine an active literary correspondence was not only carried on, but was maintained by means of a foreign language and an extremely complicated script. There must have been plenty of schools and teachers, as well as of pupils and books.

The latest revelation that has been furnished to us by the tablets of Telel-Amarna relates to Jerusalem. Among the tablets now in the Museum of Berlin, five have been found which prove, upon examination, to have been letters sent from the King or Governor of Jerusalem to the Egyptian sovereigns in the century before the exodus. The governor in question was named Abdi-dhaba, or Ebed-tob as his name would have been written in Hebrew. He describes himself as occupying a more independent position than the governors of most of the other towns of Palestine. They were merely Egyptian officials. He, on the other hand, though he owned allegiance to the Egyptian monarch, nevertheless claims to have derived his power from "the oracle of the mighty king." As one of the letters shows that this "mighty king" was not the king of Egypt, but a deity, we are irresistibly reminded of Melchizedek, the king of Salem, and priest of "the most high God," from whom, therefore, the king derived his authority. Last spring I had already recognized the name of "Urusalim," or "Jerusalem," in one of the Telel-Amarna tablets at Cairo, and one of those which I copied in the collection of M. Bouriant tells us what was the local name of the "most high God." The tablet is unfortunately broken; but on one side of it we read, "The city of the mountain of Jerusalem, the city of the temple of the god Uras, (whose) name (there is) Marru, the city of the king which adjoins (?) the locality of the men of Keilah." Marru seems to be the same word as the Aramaic *marê* ("lord"). He was identified with the Babylonian Uras, and his temple stood on "the mountain" which was called Moriah, perhaps in remembrance of the god. Long before the days when Solomon built the temple of Yahveh the spot on which it stood had been the site of a hallowed sanctuary.

The tablets at Berlin refer to transactions which had taken place between Addi-dhaba and the "Kassi" or Babylonians; and in one of them an oracle of the god of Jerusalem is quoted which declared, that, "so long as a ship crosses the sea,—this (is) the oracle of the mighty king,—so long shall the conquests continue of Nahrima and the Babylonians." Since Nahrima is the Aram-Naharaim of the Old Testament, light is thrown on the account which is given us in the Book of Judges of the eight-years' occupation of southern Palestine by the king of that country. In Chushanrishathaim we must see a successor of the princes whose conquests were proclaimed by the oracle on Moriah. It was an anticipation of the career which Balaam predicted for "the Star of Jacob."

Light is also thrown on a statement of the Egyptian historian Manetho, which it has been the fashion to treat with scant respect. He tells us that when the Hyksos were expelled from Egypt they built Jerusalem as a defence; not against the Egyptians, as would naturally be expected, but against "the Assyrians." In the age of Manetho, "Assyrians" and "Babylonians" were synonymous terms.

But though it is to the tablets of Telel-Amarna that we must look for light upon the history of the Canaan which the tribes of Israel invaded, it is rather from the monumental records of ancient Arabia that we may expect to draw our chiefest illustrations of the inner life and belief of the invading tribes themselves. One of these illustrations has already been indicated by Professor Hommel.[1] In one of the Arabian inscriptions discovered by Euting we find the word *law'ân* used in the sense of "priests." The word is etymologically the same as the Hebrew Levi; and when we remember that Jethro, the priest of Midian, watched, as it were, over the birth of the Israelitish priesthood, and had as his son-in-law the Levite Moses, there opens out for us, as Professor Hommel remarks, "a new and unexpected perspective in the history of religion."

A. H. SAYCE.

[1] Aufsatze und Abhandlungen zur kunde der Sprachen, Literaturen und der Geschichte des vorderen Orients, Munich.

VASSAR STUDENTS' AID SOCIETY.

THE first annual meeting of the Vassar Students' Aid Society was held at Sherry's, Fifth Avenue and 37th Street, New York, on Saturday, Oct. 25, 1390.

The meeting was called to order by the president, Mrs. J. R. Kendrick, who emphasized in a brief address the relation between the work of this society and the general movement of the day toward the wider extension of the higher education, and spoke of the enduring nature of its task.

The secretary reported that the society now numbers 17 life-members and 374 annual members, including residents of Mexico, Germany, South America, and India. Many encouraging letters were received from former students, expressing sympathy with the objects of the society, and no little pleasure in being allowed to claim a place among the daughters of Vassar and in the opportunity for acknowledging their indebtedness for the benefits received at her hands. The work of securing new addresses has been continued through the generosity of a member who gave printed lists covering the years from 1865 to 1869. A non-graduate who received a copy of one of these wrote forty letters, and obtained information in regard to seventeen former students,—an incident which illustrates not only the amount of work involved in this search, but also the general willingness to help, which has made possible the measure of success the society has achieved.

In March the state of the treasury warranted the announcement of a scholarship, to be awarded in June, 1890. As the society represented widely separated sections of the country, it was deemed fairest to all to open as widely the competition for the scholarship. The late announcement prevented the majority of the applicants from adapting their preparation to the college requirements, and but two passed the examination unconditionally. Both are now in college, the second as the recipient of aid from the college.

The treasurer reported a total of $751 98 received since October, 1889,—from 17 life-members $425, from annual members $326.98; cash paid for scholarship, $200; for printing, postage, and sundries, $117.93; and a balance in treasury, including life-membership fees, of $434.05.

The organization of a Minnesota branch at St. Paul, Nov. 22, 1889, has been followed by the formation of branches in Boston, New York, Brooklyn, Poughkeepsie, Orange (N.J.), and Louisville (Ky.), and the appointment of committees in other centres. These branches reported the details of their organization, their plans for extending their influence by the admission of associate members and by giving series of lectures, and made announcement of local scholarships as follows:—

The Boston branch, to residents of localities represented by the branch, a scholarship of $200 for competition in June, 1891. Application must be made to Mrs. Frank H. Monks, Monmouth Street, Brookline, Mass.

Brooklyn branch, to residents of Long Island, a scholarship of $100, tenable four years, to be awarded in June, 1891. Application should be made to Mrs. Charles O. Gates, 100 Greene Avenue, Brooklyn.

Kentucky branch, to residents of the State, a scholarship, probably of $400, for competition in June, 1891; application to be made to Mrs. Patty B. Semple, 1222 Fourth Avenue, Louisville.

The New York and Poughkeepsie branches anticipate being soon able to announce one each for award in June.

The parent society also offers two scholarships, of $300 each, for general competition in June, 1891 and 1892 respectively. Application must be made to Miss Jessie F. Smith, South Weymouth, Mass.

Application for these scholarships must be made before May 10

The balloting to fill the vacancies caused by the expiration of terms of office resulted in the election of Professor Abby Leach, Mrs. George H. Mackay, Professor Mary W. Whitney, and Miss Rachel Jacobs.

Invitations to the public meeting had been sent to about five hundred friends of education and of Vassar. Dr Mary Taylor Bissell presided. In a stimulating address, Dr. Taylor dwelt upon the advantages of the principle of co operation in the bestowal of aid to students, and pointed out the importance of extending assistance to those who were willing to prove their capacity by entering a competitive examination, and who showed their desire to be self-reliant in their willingness to accept these scholarships in the form of a loan.

THE PRESERVATION OF TIMBER.

IN countries where timber is cheap, labor expensive, and money scarce, it does not pay to apply preservative substances to wood to delay or prevent its natural decay. A very rapid calculation will show that wages, cost of chemicals, and compound interest together, represent a sum greater than the cost of frequent renewals. However, the wastefulness of settlers in new countries, and the steady accumulation of capital in the old ones, are rapidly doing away with this condition of affairs. Timber is growing both scarce and dear, while increased means of communication have reduced wages in places formerly on the outskirts of civilization. Even in this country, where timber was once so plentiful that care was not even exercised to cut it at a period of the year when it was at least filled with sap, and when "seasoning" was never thought of in the hurry of railway construction, considerable attention is now being given to preservative processes. Unfortunately the desire to carry them out cheaply has often brought them into discredit. Homœopathic quantities of antiseptics have been not unfrequently used, the action being confined to the outside of the timber, and being quickly dissipated by the action of air and moisture.

Engineering of Nov. 21 gives a history of attempts at prolonging the life of timber, from which we take the following:—

In 1836, Dr. Bouchorie, a French chemist, tried to impregnate timber by vital suction; that is he tapped the tree, and allowed the ascending sap to carry up a preserving solution. This, however, did not give satisfactory results, and in place of it a cap was supplied to the end of a newly cut log, and the solution forced along the sap ducts by hydraulic pressure Sulphate of copper was the chemical used; and, when it was applied to newly felled timber, it gave good results. Lime water has been tried, and also salt, but the effects have not repaid the trouble. There is a strip of road in the Union Pacific Railroad, in Wyoming Territory, where the sleepers do not decay at all. The analysis of the soil shows that it contains sodium, potassium chloride, calcium, and iron, which act as preserving agents. An inventor named Foreman brought out a process by which dry arsenic and corrosive sublimate were inserted in holes in sleepers, and covered with plugs. The materials became dissolved, and effloresced on the surface, when the cattle licked them and died by scores. The farmers rose in arms and forced the railroad company to burn all the sleepers. Many other attempts might be narrated: indeed, the entire list of antiseptic substances appear to have been ransacked to find something both cheap and effective.

The chief processes that have been employed for the preservation of timber are kyanizing, burnettizing, and creosoting; that is, impregnation with bichloride of mercury, with sulphate of zinc, and with creosote. Many others have been proposed and tried, but only these three have survived. The first seems to be well adapted for bridges, or for timber exposed to weather alone, and not to constant moisture. Examples have been found in this country which were in a good state of preservation after twenty eight years' exposure; but, when kyanized timber has been used for railway sleepers and pavements, it has had only a doubtful success, probably in consequence of the washing-out of the corrosive sublimate. The wood is allowed to steep one day for each inch in thickness of its least dimension, and one or two days in addition. The solution contains 1 per cent by weight of corrosive sublimate and from four to five pounds of this are absorbed per thousand feet, board measure. Burnettizing may be performed in the same way, sulphate of zinc being the chemical employed; but it is usual to steam the timber first to open the pores, and then to subject it to a vacuum to withdraw the sap. If this be not done, the timber must be stored for a considerable time to allow it to dry naturally. When treated, the wood should not be placed in exposed situations, such as bridges, or else the zinc will be washed out and leave it unprotected. This is partic-

ularly true when weak solutions are used; and when the potency is greatly increased, the tenacity of the timber is impaired. In Germany 1.91 per cent is considered the proper strength for railway-sleepers. Several suggestions have been made to confine the zinc in the timber. Mr. W. Thelmany proposed to subject the timber to a subsequent bath of chloride of barium, with the view of producing an insoluble sulphate of baryta. It is doubtful, however, if the re-action would go on in the minute sap-ducts of the wood. Another process is that of Mr. Wellhouse, who also employs a double solution, the first being chloride of zinc to which a little glue is added, and the second a solution of tannin. It is claimed that the latter, upon coming in contact with the glue, forms small particles or films of artificial leather, which plug up the mouth of the sap ducts, and prevent the zinc being washed out. Certain experiments which have been made seem to confirm the idea. Another plan consists in using a solution of chloride of zinc and gypsum. The gypsum crystallizes and hardens inside the sap-ducts, and forms partitions to hold the zinc within the cells There are three burnettizing works in the United States; and the cost of the process is about five dollars per thousand feet board measure, or from twenty to twenty-five cents a sleeper.

Creosoting is so well understood that it scarcely needs description. It is in almost universal use for sleepers for English railways, and no other process has been commercially proved capable of resisting the *Teredo navalis* and *Limnoria tenebrans*. In England and Holland from ten to twelve pounds of creosote-oil per cubic foot of timber are found sufficient for harbor purposes; the French use nineteen pounds for the same purpose; and a similar quantity has been found necessary in the Gulf of Mexico, where the marine worms cut off an unprepared pile in eight months. The creosoting process needs to be well done to be effective, and for ordinary purposes from eight to twelve pounds are required per cubic foot of timber.

It was generally considered that the presence of heavy oils in the creosote was objectionable, and therefore engineers were accustomed to specify that not more than 10 per cent should be present. This view has been controverted by others, who take the view that it is only the heavy oil which can be relied upon to exert a continuous preservative action, the creosote itself being liable to become dissipated in course of time. This view receives confirmation by the good results of the preservative process introduced by Mr. Henry Aitken of Falkirk. This consists simply in soaking timber in melted naphthaline for a period varying from two to twelve hours, depending on the bulk of the piece. A temperature of 180° to 200° F. is all that is required for the process, and is most easily obtained by placing steam-pipes in the bottom of the tank which contains the material. Simple as the process is, that is not its chief merit. A more valuable feature is that it can be applied to green timber, thus doing away with the long and expensive process of seasoning. The naphthaline makes its way through the pores of the wood, decomposing the albuminoid compounds, and displacing both sap and water. It then becomes fixed, and the whole substance is permeated with solid antiseptic of a permanent character.

Aitken's process was introduced in 1882, and three years afterwards an account was given in *Engineering* (July 3, 1885) of certain trials that had been made to demonstrate its utility. Among these were mentioned the construction of some railway-wagons for the North British Railway. These were made from logs taken direct from the timber-pond and naphthalized. The logs were cut up and worked in the usual way; for, unlike creosoting, the Aitken process does not render timber more difficult to cut, neither does it interfere with painting or varnishing. The wagons have, up to the present, shown no signs of decay, and all the joints are tight. When taken apart, the tenons still show the chisel marks, demonstrating that they have not been working in the mortises. On the same railway there were placed sleepers and keys, and after seven years these are still perfectly fresh. One of these keys is in perfect condition, and does not appear to have been touched since it was first driven. Four years ago fencing-slabs of poor Swedish timber, some already beginning to decay, were naphthalized and put down, and to-day they are in as good a condition as ever.

In coal-pits equally good results have been obtained; and larch timbering, which usually becomes quite rotten in five years, has remained perfectly sound. White ants and the *Teredo* do not find naphthaline more palatable than creosote, for samples laid in the harbor of Colombo have been carefully avoided by both pests.

In England there are only two methods of preserving timber in general use; namely, careful seasoning and creosoting. The latter is only applicable to rough work, such as sleepers, fencing-posts, and the like; while the former is expensive, and is only moderately successful in the case of soft timber. It remains to be seen if the Aitken process will take rank with the others and obtain general acceptance. It is full of promise, and, if it fulfils only a part of what appears to have been proved for it experimentally, will be a valuable addition to the means of fighting the deteriorating influences of time and weather. For many purposes hard woods are employed simply on account of their great durability; the cheap, soft woods being, in other respects, equally well suited. If the soft woods can have their lives prolonged, a great saving can be effected in most cases. The sudden seasoning said to be effected by naphthaline, without sensibly hardening the wood or rendering it difficult to work, deserves to be carefully investigated, as it would liberate an immense amount of capital now lying idle, besides preventing the annoyance resulting from the use of half-seasoned timber. Every thing that offers to cheapen production is worth trying in these times of fierce international competition.

THE FORESTS OF ANNAM.

THE forests of Annam have recently, says the French *Moniteur Official des Commerce*, been explored by one of the officials of the Forests Department, who was instructed by the French Government to examine and report upon them, particularly with reference to their extent and the possibility of their practical utilization. The first information obtained upon the subject relates to the forests of Nghê-An, in the province of Vinh. These forests, says the *Journal of the Society of Arts* (London), quoting from the above-named periodical, are situated in the mountains and at some considerable distance from the coast, covering almost the whole of the district watered by the Song Ca River, commencing at Luong, and its principal tributary the Song-Cong. The lower vegetation covering the soil, and the almost impenetrable network of tropical climbers which reach up to the higher branches of the trees, render it extremely difficult to penetrate far into the heart of the forests.

The woods met with in the forests of Nghê-An are very varied and numerous; but the most important, and those in which considerable trade is carried on, are the *go-liem*, or iron wood, and the *govan-tam*. The other descriptions of wood, although often more valuable, are much rarer, and therefore less frequently met with on the various markets. The *go-liem*, or iron wood, is hard but brittle, of a brownish-red color, and would last a very long time were it not for the injuries inflicted upon it by white ants, which attack and speedily destroy it. In spite of this, it is eagerly sought after, and is of great utility, being employed in the construction of columns for pagodas and houses, piles for bridges and platforms, furniture, coffins, junks, etc. Its weight is about 1,100 kilograms the cubic metre. It takes a good polish, and hardens in course of time. It is brought to market in logs of from five to eight metres in length, and sometimes, but less frequently, from ten to twelve metres in length. The *go-liem* is largely exported. The *govan-tam* is a yellowish-white wood, with a very fine grain. It is easily worked, is very light, and polishes well. It is used for the common kind of furniture, mouldings, boxes, and ordinary coffins, the hulls of junks and sampans, oars, etc. Its most frequent use is in ship-building.

Beyond these two descriptions, which, from a commercial point of view, are the most important, there are a number of other woods little used by the Annamites, either on account of their scarcity, or because they are considered to be little capable of being worked up. They are, however, says M. Thomé, well deserving of some attention, by reason of the fact that Europeans might find a use for this excellent raw material which the Asiatic appear incapable of doing.

The principal of these woods are the following. The *sanglê* is a yellowish-brown wood, which gets darker with time. It is a rare and very dear wood, not decaying under water, very heavy, and susceptible of a good polish. It is frequently employed in the construction of the better class of junks, and is sold in the markets in logs sawn through the middle. This is done because the purchaser, paying a high price for this particular description of wood, insists upon seeing the condition of it throughout. This wood has no sap, and it frequently attains a height of 18 metres. The *yê* is a rose-colored wood, scented, and capable of a good polish. It is light, and is not attacked by ants. There are two varieties of this wood,—the *yê-baï*, or white; and the *ye van*, or yellow. The *ven* is a dark-yellow wood, becoming brown with age. It is light, and is fit for ordinary carpenters' work. The *gavï* is a yellowish-white wood, heavy, and with long fibres. It is sold in planks from 12 to 15 metres long, and is used for framework and in the construction of junks. The *tio* is a red, hard, and heavy wood, with a coarse grain; and the *tine* is a purple-colored wood, tender, and with very fine grain. The latter, says M. Thomé, might well be used for cabinet-making. The *goï* is a red-colored wood, and the tree attains a height of from 10 to 13 metres. It is useful in carpenters' and cabinet-makers' work. The *bop* is a white wood, extremely light (very much resembling cork), polishes well, and would be useful to joiners. The *meucque* is a light, white wood, used for making *sabots* for the Annamites. The *goo* is a very fine, light, and well-veined wood, becoming black with age, scarce in Nghê-An, but abundant in Ha-tinh. It is used for inlaying work. The oak, thus named because it resembles the European oak, is a heavy wood of mahogany color, has a good polish, and is used in cabinet-work.

Among the other principal woods in which a considerable trade is carried on, may be mentioned the bamboo, rattans, *cunao*, *vang sao* (a parasite plant used in Chinese medicine, and very expensive), and cinnamon. From the clearings to the banks of the river, the logs and planks of wood are dragged by buffaloes. Rafts are then formed, which descend the stream from Nghê-An and Ha-tinh in all seasons except when the waters are exceptionally swollen. During the dry season the streams have always a sufficient amount of water to allow the rafts to go down to the sea. The province of Nghê is one of the richest in Annam from a forest point of view; and the Song-Ca and Song-Cong, streams which traverse the forest region, form excellent means of transport for articles so heavy and cumbersome as timber.

GEM-MINING IN SIAM.

THE region in which gems, including rubies and sapphires, have for the past ten years been found, lies situated on the western side of the Cambodian peninsula, about 240 miles south-east of Bangkok, and covers approximately an area of 100 square miles. The centre of that district is Chantabun, a seaport with a good harbor, connected with Bangkok by a line of three small steamers running at regular intervals. It is stated in a recent report to the foreign office that within three hours' walk from Bangkok, to the northwest, is Ban Kacha, where rubies of a very inferior kind are still sought after by the local inhabitants, both Siamese and Chinese. Tongsoos, or natives of Pegu, and Burmese, do not work there. Again, twelve hours distant from Chantabun are the mines of Müang Krung, with a mining population of about 100 in all, mostly Tongsoos, with a few native Siamese and Chinese. Two days' journey from Chantabun, in a southerly direction, is the district of Krat, with mines from which rubies are extracted, and but few sapphires. The Tongsoo workers there number about 3,000. On the eastern side of the hill range, and three days' journey due east from Chantabun, midway between that town and Battambong, are the Phailin mines, the most extensive and most frequented of all. Here there are between 4,000 and 5,000 gem-seekers. Rubies and sapphires are both found, the latter being more abundant. The rubies at these diggings, although more rarely met with, are said to be of higher value than those discovered at other places in Siam. A stream which rises in the hill ranges passes through the neighborhood of the mines on its way to the Thale Sap and the Cambodia River. All three of these localities—Krung, Krat, and Phailin—have been, or shortly will be, conceded on mining leases.

The method of obtaining the precious stones, as described in the *Journal of the Society of Arts*, London, is identical at all the diggings in the region of Bangkok, and is as follows: The intending digger, on entering the district, pays three ticals (5s. 3d) to the head man,—a Burmese British subject appointed by the British Legation, and responsible to the governors of Battambong and Chantabun, according as the fees received are derived from the Phailin or Krat mines. Beyond this tax there is no further fee exacted. The Siamese Government claim no right to pre-empt gems found, or to purchase at market value all stones above a certain carat weight, as was the case in Burmah. The Tongsoo digger's first object is to discover a layer of soft, yellowish sand, in which both rubies and sapphires are deposited. This stratum lies at depths varying from a few inches to twenty feet on a bed of subsoil, on which no precious stones are found. A pit is dug until this corundum is exhausted; and the soil removed is then taken to a neighboring canal or stream, one of which runs in the proximity of the mines both at Phailin and Krat, where it is mixed with water, and passed through an ordinary hand-sieve. In his search for this peculiar alluvial deposit, which is generally free from any admixture of clayey earth, the digger has often to penetrate into the jungle that grows thickly around, combining the work of clearing with the occupation of gem-digging.

The Tongsoos do not appear to form themselves into companies for mutual assistance or division of profits. They work principally in twos and threes; and, if chance lead them to discover a gem of any value, they either undertake a sea-voyage to Rangoon or Calcutta for the purpose of obtaining a good price for it themselves with the dealers in precious stones at these places, or consign their acquisitions to an agent, while they themselves continue to search for more. A process of migration is continually going on among the Tongsoos of the different mines, the workers passing from one to the other, according to the reputation of a particular mine at certain periods.

No artificial or mechanical processes for the washing of the soil have as yet been introduced, nor have gems been discovered in fissure veins of soft material embedded in crevices of hard rock or in crystal form. Rubies and sapphires are found at all the diggings, often deposited side by side in the same layer or stratum of sand. The ruby of "pigeons' blood" color is rarely, if ever, met with. The color of the Siam ruby is usually light red of a dull hue. The sapphire is of a dark, dull blue, without any of the silken gloss which is the distinctive mark of the Burmah and Ceylon stone. Stones resembling garnets rather than rubies are found in the dried beds of water-courses at Raheng, two hundred miles north of Bangkok; and there is every reason to believe that rubies also equal, if not superior, to those discovered in the southeast, exist throughout the Raheng district. Those hitherto obtained are the result merely of surface scratchings by the Tongsoo seekers.

NOTES AND NEWS.

THE encouragement received in New York since April 1 by George L. English & Co., mineralogists, has been such as to lead them to the decision to concentrate their entire business in the metropolis. It is their purpose, therefore, to transfer their Philadelphia stock to New York on Jan. 1, 1891. For the present they will remain at 739 and 741 Broadway, where, with new fixtures, a greatly enlarged stock, and an increased corps of assistants, they hope to merit and receive a growing patronage.

—The production of kirschwasser in Switzerland is carried on in the cantons that produce the best cherries; namely, Basle-Campagne, Bern, Aargau, Freyburg, Grisons, St. Gall, Lucerne, Upper Unterwalden, Soleure, Schwytz, Valais, Vaud, Zug, and Zurich; that is to say, in fourteen cantons out of twenty-two. The United States consul at Lucerne says that the principal distilleries are in the following cantons: Basle, Lucerne, Schwytz, and Zug. The others are small concerns, consisting of one, two, or at most three, stills. The manufacture of kirschwasser is also carried on to a great extent by the farmers. For the distillation of kirschwasser,

both black and red cherries are used; but the former are preferable, as producing a spirit of finer quality, and in greater quantity. According to the *Journal of the Society of Arts* (London), there are no special methods of cultivation, the cherry-trees being generally in the same orchards with apple and pear trees; but, as this is the first fruit on which the farmers can realize money, they naturally pay great attention to their cherry-trees. The process of manufacture is as follows: The cherries are first carefully cleansed, great importance being attached to this point; the stems are then removed, and the fruit packed in very thick wooden casks, and left to ferment for a period of from five to eight weeks, according to the weather; after which it is ready for distillation. In large distilleries the stills contain from 220 to 264 gallons, while in the smallar ones the quantity varies from these figures to 11 gallons. The large distilleries, with one or two exceptions, make use of indirect steam as a means of heating, the stills being constructed with double bottoms, through which steam passes. The others employ naked fires, the fuel consisting of peat or the refuse of cherries and pears after distillation, which is compressed into bricks, and dried. Both methods of heating have numerous advocates, who each claim the superiority of their system. Kirschwasser is placed on the market in litre (1.76 pints) bottles, in carboys containing from 10 to 60 litres, and in casks. The wholesale market value of kirschwasser varies very much, according to good or bad crops, and consequently according to the price of fruit in good seasons; the price of new pure kirschwasser being sometimes as low as two francs per litre, while in bad seasons it is sometimes as high as four francs, the average being about three francs. All distilleries, it is said, even the best with one exception, adulterate their kirschwasser by the addition of cheap spirit of wine or spirit of potatoes (which is imported from Germany), according to the price offered by the buyer, the cheaper qualities consisting of about three parts of spirit to one part of kirschwasser. All distillers guarantee the purity if the full market price is paid. It is impossible to state with any accuracy what is the annual production. Different statements put down the average at from 300,000 to 500,000 quintals (a quintal is equal to 1.9 hundredweight). The principal markets for kirschwasser are North America, South America, and British India. France also imports a considerable proportion of the kirschwasser of Switzerland.

—Mr. William Hamilton Gilson, the well-known artist and illustrator, has accepted charge of the illustration class of the New York Institute for Artist Artisans.

—The efforts which have been made to open commercial communication between England and the heart of Siberia by way of the Arctic Seas have at last been successful, according to *Nature* of Nov. 27. A correspondent of the London *Times*, who signs himself, "One who knows all about it," explains the circumstances connected with this remarkable triumph of skill and energy. Two ships and a tug for river-work were despatched from London at the end of July and beginning of August. Owing to north-easterly winds, the Kara Sea was exceptionally full of ice, so that the ships were detained for some days among ice-floes. Nevertheless, in thirty-nine days the ships and tug reached Karaoul, 160 miles up the Yenisei, without accident. They remained there nineteen days, and took twenty-six days to return. They were thus only eighty-four days, or two months and twenty-three days, away from the London Docks. At Karaoul they met the river expedition, which "returned safe to Yeniseisk a few days ago, and is now landing and warehousing there the valuable cargo sent out from England." The same correspondent points out that the real *crux* of the expedition lay in the 160 miles of estuary between Golcheka, at the mouth of the Yenisei, and Karaoul, at the head of the estuary, which the Russian Government had assigned as the port of discharge. Last year the "Labrador" would not ascend to Karaoul, because Capt. Wiggins thought there would not be water enough to take him there, and had no steam-launch to enable him to feel his way up. On the other hand, the river-ship did not dare to descend on account of the gales that then prevailed. This year it was discovered that through the entire estuary there was a channel with sufficient water for ships of any draught, and the ships proceeded up the river to their destination without hinderance. It is unfortunate that Capt. Wiggins was accidentally prevented from completing the work with which his name has been so intimately associated; but it was he who showed the way, and to him, more than to any one, belongs the honor of having provided this new outlet for British commerce. That it may become an outlet of the highest importance is the conviction of no less an authority than Baron Nordenskiöld. In a letter congratulating the promoters of the undertaking, he says, "I am persuaded that its success will once be regarded as an event rivalling in importance the return to Portugal of the first fleet loaded with merchandise from India. Siberia surpasses the North American continent as to the extent of cultivable soil. The Siberian forests are the largest in the world. Its mineral resources are immense; its climate, excepting the *tundra* and the northernmost forest region, healthy, and as favorable for culture of cereals as any part of Europe." He goes so far as to say that the future of Siberia may be "comparable to the stupendous development which we at present see in the New World."

—The many instances of strange doings by excited men are matched by an incident said to have occurred recently in England during a run with the hounds of Sir Watkin Williams Wynn. In passing a cottage the fox suddenly found himself among a lot of fowls. Absolutely regardless of possible consequences, he snatched up one of the birds, and carried it in his mouth to the end of the run, and was killed with it in his mouth. This is given for what it is worth.

— A discovery which may lead to important results has been made by M. Chabrié during the course of his experiments upon the properties of the recently isolated gaseous fluorine substitution products of marsh-gas, as we learn from *Nature* of Nov. 27. The intimate relation between these bodies and chloroform, and the possibility of their possessing even greater physiological activity, led M. Chabrié to investigate the action of one of them, methylene fluoride (CH_2F_2), upon specific microbes, with the result, that, in the case of the particular bacillus experimented upon, the gas is found to absolutely destroy them. The bacteria in question, which have formed the subject of these first experiments, were those discovered by M. Bouchard, in 1879, in urine. Two eprouvettes of equal size were taken and filled with mercury over a mercury-trough. Equal small quantities of urine containing colonies of the bacteria were introduced into each, and afterwards a mixture of air and methylene fluoride admitted into one of the eprouvettes, and an equal volume of air alone into the other. The two vessels were both maintained at the temperature of the body, 35°, for twenty-four hours. At the end of this time a few drops of the urine from each of the vessels were introduced into separate flasks containing sterilized culture medium, and both maintained at the same stove temperature for twenty-four hours, and again for forty-eight hours. At the expiration of this period the urine which had stood in contact with air alone was found to have given rise to a flourishing colony of the bacteria, while that which had been in contact with the mixture of air and methylene fluoride had not given rise to a trace of a culture. According to MM. Albarran and Hallé, twelve hours are ample for the development of this bacillus, hence methylene fluoride had evidently been fatal to the germs. The experiment was again repeated without the use of mercury, in sealed tubes, but with the same result It appears, therefore, that methylene fluoride possesses the property of destroying the urinary bacteria in question. M. Chabrié has made special experiments in order to determine whether the gas possesses any local irritant action; and the results, as far as they go, appear to be eminently satisfactory. He is now directing his experiments upon the microbe of the hour, that of tuberculosis, and his results will doubtless be watched with considerable interest. Methylene fluoride is easily prepared by heating silver fluoride with methylene chloride in a sealed tube. M. Chabrié has also succeeded in preparing the higher homologue, $C_2H_4F_2$ (ethylene fluoride), by the analogous re-action with ethylene chloride, and is extending his observations to the antiseptic properties of this latter gas.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

THE BOTANICAL MYTHOLOGY OF THE HINDOOS.

AT a recent meeting of the Anthropological Society of Bombay, as we learn from *Nature* of Nov. 13, Dr. Dymoke read a very interesting paper entitled "The Flowers of the Hindoo Poets," in the course of which he referred to the mythical conceptions which have gathered round trees and plants in the minds of the Hindoos. the ancient Eastern poets saw in the tree a similitude with the heavens and with the human form. In the "Gitagovinda" a comparison is drawn between the clouds and the thick dark foliage of the *Tamala*. These fancies gave rise to the numerous poetical myths concerning the tree of life, of knowledge, of the *Amrita* or ambrosia, as well as those concerning cosmogonic and anthropogonic trees. The *Soma* or *Amrita* is represented as the king of plants, the eternal essence which constantly sustains and renews the life of plants and animals. It is the symbolical drinking of this eternal essence as a holy ceremony to which constant allusion is made in the Vedas:—

"We've quaffed the Soma bright,
And are immortal grown;
We've entered into light,
And all the gods have known."
Rig Veda, viii.

The *Amrita* appears in various forms in stories and legends. A famous poet says that the drop (*Svedavindu*) which fell into the shell became a pearl; in the mouth of the black snake it became poison; and in the flower of the plantain, nectar. Several plants bear this name, and are supposed to be endued with an extra particle of the eternal essence, among others the *Neem*, on which account the Hindoos, on their New Year's Day, eat the leaves of this tree upon the supposition that the *Amrita* contained in them will insure longevity. In Hindoo flower-lore the large black bee (*Buramara*) plays an important part: he is the inconstant lover who delights in gathering sweets from every flower. The queen of Indian flowers is the lotus. The Hindoos compare the newly created world to a lotus-flower floating upon the waters, and it thus becomes symbolical of spontaneous generation. The golden lotus of Brahminic and Buddhistic mythology is the sun, which floats in the waters which are above the firmament, like an earthly lotus in the deep blue stream below. From it distils the *Amrita*, the first manifestation of Vishnu. Brahma and Buddha (the supreme intelligence) were born of this heavenly lotus. Lakshmi, the Indian Venus, is represented sitting on this flower. The Hindoos see in the form of the lotus the mysterious symbol *Svastika*. The allusions to this flower by Indian poets are innumerable. No praise is too extravagant for it. It is the chaste flower, and its various synonymes are bestowed as names upon women. The red lotus is said by the poets to be dyed with the blood of Siva, that flowed from the wound made by the arrow of Kama, the Indian cupid. The face of a beautiful woman is compared by the poets to a lotus-blossom, the eyes to lotus-buds, and the arms to its filaments. The bee is represented as enamored of the lotus. Although a humble little flower, the *Tulasi* is almost as great a favorite as the lotus. It is addressed to the goddess Sri or Venus. The heart of Vishnu is said to tremble with rage if a branch of his beloved is injured. The plant must be gathered only for medicinal or religious purposes, such as the worship of Vishnu or Krishna, or the wife of Siva. It is a kind of *Amrita*, symbolical of the eternal essence. It protects the worshippers, and gives children to women. The plant is often worshipped as a domestic deity, and its branches are placed on the breasts of the dead. The *Champa* is chiefly celebrated for its overpoweringly sweet odor and golden color. So strong is its perfume that the poets affirm that bees will not extract honey from it; but they console it for this neglect by dedicating it to Krishna, who loves garlands of yellow flowers as becoming to his dark complexion. One of the greatest favorites of the poets is the *Asoka*. Its flowers, which are yellow when they first open, gradually change to red. In March and April it is in its glory, and at night perfumes the air with its delicate odor. The tree is the *kul*, or anthropogonic tree of the Vaisya caste, who call it *Asupala*. The kadamba (*Anthrocephalus cadamba*) is sacred to Kali or Parvati, the consort of Siva. It has many synonymes, such as "protecting children," "dear to agriculturists," etc. It blossoms at the end of the hot season, and its night-scented flowers form a globular orange-colored head, from which the white-clubbed stigmas project. The flowers are fabled to impregnate with their honey the water which collects in holes in the trunk of the tree. In Delhi the goldsmiths are fond of imitating the flowers. The well-known prickly gold beads so often seen in Delhi jewelry are meant for kadamba-flowers. In this part of India the Marathas will not gather the flowers for profane purposes, as it is their anthropogonic tree. The Kadamba Rajas claim their descent from it, as recorded in the following legend: "After the destruction of the demon Tripura, a drop of perspiration fell from the head of Isvara into the hollow of a kadamba-tree, and assumed the form of a man with three eyes and four arms. He became the founder of Vanavasi or Jayantipur." There are other versions of the story, but all agree in connecting the origin of the family with this tree, a branch of which is necessary to represent the Kai at a Marathi marriage ceremony.

HEALTH MATTERS.

Adventure of an Hypnotic Subject.

THE *Lancet* of Aug. 2, 1890, contains the following: In Rome the other day, in that church of the Ara Cœli where Gibbon, as he himself tells us, conceived his "History of the Decline and

Fall" of the empire, a young man of foreign appearance, about five in the evening, was seen to be making the round of the several chapels. Suddenly he stopped before the altar of St. Francis of Assisi, and remained in rapt attention before the picture of the saint. More than an hour elapsed, and he was still seen standing, perfectly motionless, his eyes fixed on the well-known painting. At last the *custode*, as it was time to close the church, told him that he must withdraw. The stranger seemed not to hear, and moved neither a foot nor a muscle, still gazing as if in ecstasy at the picture. The *custode* shook him, and urged him to go, but in vain, till at length the Municipal Guard were called in, and the young man was lifted bodily from the pavement, and taken first to the station-house, and then to the Ospedale della Consolazione. The guard had tried to bring him to consciousness by dashing water in his face and shaking him; but, finding these measures ineffectual,—the man remaining with his eyes fixed on some invisible object above, and not a muscle of his body stirring,—they brought him to the medical waiting-room of the Consolazione. There the physicians immediately pronounced the case to be one of hypnotism, and, after various remedies had been tried without success, they at last succeeded in bringing him to consciousness by hypodermic injections of ether. On coming to himself, the patient turned out to be a Bavarian; and one of the attachés of the German Embassy, who had been summoned, identified him as a young, recently graduated physician of Munich, who had been subject to hypnotic fits for some time past. Thanking all the officials—medical, municipal, and diplomatic—for the care and kindness he had experienced at their hands, he returned to his hotel. The Roman press, commenting on the occurrence, remarks that two or three centuries ago the same phenomenon would have been regarded as treasure-trove by the church, and the chapel of St. Francis of Assisi, in the Ara Cœli, would have attracted crowds of pilgrims eager to come under the direct influence of the saint. Medical science, however, may now say, "Nous avons changé tout cela."

The Protection from Diphtheria and Tetanus by Inoculation.

The Berlin correspondent of the *Medical Record* has cabled to that journal under date of Dec. 4 that he has received advanced proofs of an article on the prevention of diphtheria and tetanus in animals, based upon experiments in the Hygienic Institute at Berlin, made by Dr. Behring, assistant in the institute, and Dr. Katasato of Tokio. He states that after long experimentation, these observers claim to have cured animals suffering from either of these diseases—diphtheria and tetanus—by the inoculation of the serum from the blood of animals already infected. It is claimed by a large number of experiments, first, that the blood of rabbits protected from tetanus possesses the property of destroying the tetanus poison; second, that this property is possessed by the non-cellular serum obtained from the blood; third, that this property is of so constant a nature that it also remains active in the organism of other animals, so that notable therapeutic effects are produced by the transfusion of blood or serum; fourth, that the property of destroying the tetanus virus is absent in the blood of those animals which are not protected against tetanus, and, if the tetanus virus is injected into non-protected animals, it can be so demonstrated, even after the death of the animals, in the blood and in the other fluids of the body.

The Curability of Galloping Consumption.

The announcement by so well-known a physician as Dr. McCall Anderson that acute phthisis, or galloping consumption, is curable, excites a good deal of surprise and quite as much incredulity; yet the *Medical Record* states that Dr. Anderson reports seven cases of this character, of which five recovered.

Cancer Mortality among the Jews.

An English paper (quoted by the *Medical Record*) states that one of the lecturers at Owens College, Manchester, has put forward the assertions (1) "that no Jew or Jewess has ever been known to suffer from cancer;" and (2) that "the immunity of the Hebrew race from this frightful scourge was attributed to their abstinence from swine's flesh."

The Micro-Organisms of Standing Water.

Drs. Scala and Alessi, according to *La Rivista Internazionale d'Igiene* for August, have completed a series of experiments demonstrating that micro-organisms multiply in standing water at the expense of the organic matter liberated in the water, this multiplication being but slightly influenced by a temperature a little above zero. They note the fact that micro-organisms diminish in water charged with carbonic acid. After demonstrating that light, movement, pressure, and cold have no influence on these micro-organisms, they experimented directly with carbonic acid, their experiments resulting in the proof of the lethal action of carbonic acid on the micro-organisms of water. This action they consider analogous to that by which other ferments die in liquids produced by themselves.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Right-Handedness.

ANENT the articles in *Science* upon right-handedness and effort, by Professors James and Baldwin, it may not be amiss to call attention to the anatomical and physiological conditions that offer at least one explanation of right-handedness in most persons.

That one cerebral hemisphere stands in dominant relation with the opposite side of the body is so well known that it is only mentioned as a reminder; but it may not be generally known that the left cerebral hemisphere is larger than the right, its inner face (at the great longitudinal fissure) coming very near to the middle line, while the corresponding inner edge of the right hemisphere is well to the right of the median line. The existence, then, of greater nutrition and greater functionating ability in the left hemisphere might well be assumed. But that there is a reason for the greater size, development, etc., of the left hemisphere, is evidenced by a study of the conditions of blood-supply to the two hemispheres. The left carotid artery ascends almost perpendicularly so as to form, as it were, an elongation of the ascending aorta, while the right carotid is given off from the *arteria innominata*. The right vertebral artery is given off by the subclavian after the latter has described its arch and become horizontal, but the left vertebral arises from the apex of the subclavian's curve. There is thus the distinct advantage to the left hemisphere of a better blood-supply because of the much straighter course taken by the great channels carrying it. On the other hand, this greater directness of communication between the heart and left hemisphere explains the greater readiness with which the latter is subjected to certain forms of disease. A clot of fibrine whipped off a diseased valve is carried much more readily because of the direct route (*via* the carotid) to the left hemisphere; and in conditions of degenerative weakness of the arteries in general, those of the left hemisphere, being subjected to greater pressure in their distal ramifications, will be more apt to yield than corresponding ones in the right.

In passing, it may be mentioned that the location in the left hemisphere of the centres connected with the faculty of language is explainable on the ground of better development of that hemisphere. An admirable lecture on this subject by Professor Gerhardt appeared in *Berliner klinische Wochenschrift*, No. 18, 1887.

Concerning the different periods at which different motor activities become manifested in the human infant, it is well to remember that the voluntary motor tract is not completely developed in the human being until after the end of the first year (Flechsig), and that the fibres developing from the occipital cortex only begin to appear between the second and third months of extra-uterine life. Up to the latter period, motor activities following visual stimulation must be considered as reflex; but the use of the right hand predominantly, or at a later period from conscious choice, is a conse-

quence of the pre-existing better nutrition, and hence readier functional activity, of the left cerebral hemisphere.

JOSEPH T. O'CONNOR, M.D.

51 West 47th Street, New York, Dec. 3.

Onondaga Folk-Lore.

UNTIL recently David Cusick's "History of the Six Nations" was the chief treasury of Iroquois legends, though much could be gathered from the writings of early missionaries and travellers. These, however, paid more attention to customs of life. Of late more care has been given to the collection of stories, and with fair results, but many old tales have been forgotten. Even so prominent a legend as that of Hiawatha was unknown to the whites fifty years ago, but it may not be very old among the Indians themselves. As a frequent visitor to the New York Onondaga Reservation, I have occasionally obtained some material of this kind, part of which has been published, and can only regret not doing this earlier.

The Onondagas have a strong belief in witches, and take precautions against them. A clear-headed and intelligent Indian told me that he met a spirit one night, and described its appearance. He took a good look at it, not being afraid, for, being a Christian, he was sure no spirit could hurt him. Supposed witches are avoided or placated, but are not now punished, though once they were put to death. I have been in an unfathomed cave on the east side of the reservation, where, it is said, a witch was cut to pieces, and thrown into the rocky cleft, many years ago.

Pygmies are supposed to live under ground, sometimes appearing to men, and their old abode was pointed out to me. They are the Che-kah-ha-wha, or Small People, of the Onondagas; the Yah-ko nen-us-yoks, or Stone Throwers, of the Mohawks; and the Ehn-kwa-si-yea, or No Men at All, of the Tuscaroras.

The tale of the vampire, which caused a change in the mode of burial, was first published by David Cusick. The version given me differs somewhat from this and that of Mrs. Erminnie A. Smith. Leaving out the graphic details for another time, the story may be briefly told. A man and his wife, with their father, one night occupied a deserted cabin. As the fire went down, a skeleton form appeared, killed the old man, and began gnawing his body. This aroused the younger persons, and the skeleton retreated when they stirred up the fire. By stratagem they escaped one at a time, but were soon pursued. Their friends came to meet them when they heard their cries, and they were rescued. The people assembled, found a skeleton in a bark coffin in the house, resolved to burn it; and out of the flames came a red fox, which burst through their ranks, and disappeared in the forest.

The story of O-kwen-cha, or Red Paint, deals with the marvels of magic, in which the boy proved powerful. He saved his grandmother by overcoming the great wrestler, and brought an uncle to life. By destroying a giant he restored another uncle; and by overcoming a wonderful dog, a third. The fourth uncle was delivered by a longer and curious trial, and he returned home with them, to find his grandmother grown old. By an odd expedient he restored her young looks, twisting a stick in the loose skin of the back of the neck, until all the wrinkles were drawn out of her face. I found a resemblance, in one part of this tale, to a Canadian legend related by Mr. Chamberlain. Red Paint arranged the scattered bones, and then pushed against a tree, crying, "Look out, look out! this tree will fall upon you!" The bones united, jumped up, and ran away. In the Canadian story the boy shoots an arrow in the air, with a similar exclamation and result.

It is unlucky to shoot at the white sea-gull, the bird of the clouds, or the one that never lights on the ground, for it dives in the air, and the hunter misses his aim. If he does this twelve times, on the thirteenth he will vomit all the blood from his body. This is the bird which destroyed Hiawatha's daughter, and not the white heron.

The Great Mosquito was an immense creature, and did much harm. One story relates that the Onondagas and Cayugas destroyed him, but with much loss to themselves. Clark ascribes the victory to Hiawatha, but the usual hero is the Holder of the Heavens. On the Tuscarora Reservation, near Lewiston, the stone is shown on which he rested, and the tracks of pursuer and pursued were preserved near Syracuse, N.Y., until quite recently. The bird-like prints of the monster's feet were described to me, and the place of his death yet retains its early name. All the stories agree in making the small mosquitoes originate in the decaying body.

The Onondagas raise the old tobacco (*N. rustica*), and it is used for sacred purposes, though not restricted to them. When medicinal plants are sought, a little tobacco is strewn around the first one found, and it is left for good luck. A little bag of tobacco is attached to the wooden false face, when this is left long unused, and this still remains on the one I have. Tobacco was always burned with the white dog.

The False Faces form a society, somewhat like medicine-men, and are supposed to have magic powers. The old masks are of wood, and these are like those described one hundred and fifty years ago. Green Pond, a little west of Jamesville, is one of the reputed early resorts of the False Faces, their magic powers opening the rocky walls. They still have feasts of their own, and assist at others.

I have been often asked whether the curious silver brooches have any significance as emblems or charms. None at present, certainly. Originally made by white men, their manufacture at last passed into Indian hands, and they were used simply as ornaments. All my crosses had been worn by Pagans. I have many forms of these brooches, but they are becoming rare. They are circular, square, lyre-shaped, diamond-shaped, stars, single or double armed crosses, Masonic emblems, combinations of hearts and crowns, etc. Some persons have attached much mystery to these double-armed crosses, as though they were antique and rare. I have had a number from Onondaga Indians, who recently used them. Among many silver ornaments and brooches, I have had and seen but one brass brooch.

There are some wampum stories, and much that is curious in its use. The Iroquois had no true wampum until the Dutch came, but may have used colored sticks or quills. An Onondaga tale makes Hiawatha's wampum of eagle-quills, and ascribes the invention to him. He alone could call down the wampum bird.

Some of the old feasts and games are yet retained. Both Seneca and Onondaga snow-snakes are made, and much used; a boy often holding several in his hand, and throwing them one after another. The boys also use the javelin a great deal; and another favorite game with children is mumble-the-peg. Their name for violets signifies "heads entangled," the flowers being interlocked and pulled apart. Lacrosse has almost disappeared, base-ball taking its place. Among implements and ornaments I still find early forms; but they are fast being displaced, and some which I used to see cannot now be found at all.

W. N. BEAUCHAMP.

Baldwinsville, N.Y., Dec. 3.

Osteological Notes.

CONSPICUOUS by its prominence, occupying the lateral regions of the mammalian cranium, and connecting these with the face by an osseous bridge, is the series of bones known as the jugal or zygomatic arch. As this arch presents many modifications in the various orders, for the full understanding of its morphology it will be necessary to trace out its correlations not only with the neighboring structures, but also with the habits and environment of the animal. Composed often of three bones,—the malar or jugal in the centre, flanked on either side by the zygomatic process of the squamosal and by the malar process of the maxilla,—the arch may be reduced to two, the process of the squamosal and the jugal, or the process of the squamosal and the post-orbital process of the frontal. The number of bones present depends upon the advanced or receding position occupied by the orbit, also upon the position held by the articulation of the mandible in relation to the orbital cavity, whether this be above, below, or on a level with it. Although the arch in certain cases is very imperfect, it can never be said to be entirely absent. The strength of the jugal arch, the most important factor in its existence, depends upon its line of direction, whether this be straight or curved, and upon the amount and manner of this curvature; upon the number,

size, extent of surface, and mode of union, of its component bones. These, in their turn, are correlated with the articulation of the lower jaw, and with the amount of surface presented by the ascending ramus; with the neighboring fossæ, crests, and processes; with the dental series; and necessarily with the muscles concerned in mastication, varied as they are in their action.

The jugal arch, as it exists in the order of the *Carnivora*, offers perhaps the most instructive example of the various points to be considered in its morphology. Take the cranium of the tiger as a type of the cats (*Felidæ*). In this, the arch, composed of three bones,—the squamosal, malar, and maxilla,—presents an extraordinary, horizontal curvature, thereby vastly increasing its expanse, giving great width to the temporal fossa, and consequently allowing a corresponding development of the temporal muscle, which, taking its origin from the largely expanded surface of the parietal, and from the occipito-sagittal crest, passes forwards and downwards, to be inserted into the high, wide, oblique, coronoid process of the mandible.

The increase in length of the arch, due to the great horizontal curvature, is also seconded by the advanced position of the orbit upon the skull, and to its height above the level of the articulation of the mandible.

The vertical curvature of the arch, with the convexity above and the concavity below, denotes increased power of resistance to the strain produced by the muscular fibres of the masseter, which, springing from the under side of the arch, are carried obliquely backward and downward to be inserted into the deeply grooved ascending ramus. The action of the pterygoids, which is similar to that of the masseter, is also relatively powerful. The fibres rising from the pterygoid fossæ and plates are inserted into the inside of the angular portion of the lower jaw, and into the neck of the condyle. The suture by which the jugal process of the squamosal and the malar are joined extends very obliquely through a greater portion of the arch; this obliquity imparting much strength to the bony structure, and giving force to assist the pressure upward.

The convex surface of the transverse condyle of the mandible, received into the deeply grooved glenoid cavity, forms the hinge-like articulation fitted for the vertical action of the jaw, and which is necessary for the prehension, tearing, and division of the flesh by means of the characteristic incisors, canines, and molars.

In the order of the *Edentata*, the cranium of the great ant-eater (*Myrmecophagus jubata*) exhibits a jugal arch which is the extreme opposite of that which has been thus partially described. In the ant-eater the arch is very incomplete, consisting of a short styliform process given off by a very rudimentary jugal, and of an extremely small, tuberous, zygomatic process from the squamosal, no union being formed between the two. There is no post-orbital process of the frontal, and indeed no separation between the orbital and temporal fossæ. Under these circumstances, the muscular development concerned in the preparation of the food is very feeble, correlated as it is with the entire absence of teeth, and any necessity for mastication.

Between these two extreme modifications there are many intermediate forms of the jugal arch. In some of the *Rodentia*, although the arch is relatively weak, as shown by the downward convexity in its vertical curvature, the masseter has other points of fixed insertion, by which means the masticatory powers are fully sustained. Moreover, the antero-posterior form of condyle is received into an undefined fossa situated upon the side of the cranial wall, whereby a corresponding amount of dental energy is imparted, suited to the habits of the rodent. Cope and Ryder have attributed the peculiarities of the dental system in this order to the mechanical consequences of an increase in the length of the incisors, which increase is due to their continued use. By a similar process of reasoning it may be shown that the imperfect condition of the arch in some of the other orders is correlated with an entire absence of the teeth, with a feeble muscular energy, and a loss of mastication, all being the result of continuous disuse.

In short, it may be said in general that the great development of the arch is dependent upon modifications which are strictly due to use, while its weakened and imperfect condition is equally the result of modifications which are due to disuse.

There seems as yet no evidence afforded by paleontological research to show that the jugal arch has undergone any special changes since the days of the *Creodonta*, the ancestors of the cats. We may therefore conclude that the phylogenesis of the *Carnivora*, at least, remains essentially the same, so far as this portion of the skull is concerned.

D. D. SLADE.

Cambridge, Mass., Dec. 5.

BOOK-REVIEWS.

A Revision of the South American Nematognathi or Cat-Fishes. By CARL H. EIGENMANN, Ph.D., and ROSA SMITH EIGENMANN. San Francisco, Cal. Acad. Sci. 8°. $3.

THIS extensive work will be highly welcomed by ichthyologists. It is based on several thousand specimens from the Museum of Comparative Zoölogy at Cambridge, Mass. The material was collected chiefly during the Thayer Expedition. Besides that, numerous other collections were studied; for instance, that of Senhor Honorario, made in Goyaz, that made by his Majesty Dom Pedro II. in Rio Grande do Sul, and that made in Lake Titicaca by Professor Alexander Agassiz and Mr. S. Garman.

In all, 101 genera and 467 species are enumerated. Full descriptions of most of the species in the Museum of Comparative Zoölogy are given. The synonymy is treated in full, and the bibliography is given at the end of the volume. In this we should like to add Dr. C. B. Bruehl's "Osteologisches aus dem Pariser Pflanzengarten" (Wien, 1856), containing descriptions and figures of the osteology of *Aspredo*, *Loricaria*, and *Hypostoma*.

Besides the index of species and genera, a geographical index is added, and a map with especial reference to the localities where collections have been made. Both will be of great help to the student.

The different forms are referred to eight families, seven of which are confined to tropical America. The relationship of families and subfamilies is expressed by a phylogenetic diagram.

The nearly cosmopolitan family *Siluridæ* (it is only absent in Australia) reaches its greatest development in South America, where it is represented by six subfamilies. The *Bunocephalidæ* are found in the whole course of the Amazon and in Guiana. The *Diplomystidæ* are represented by a single genus and species from Chili, the *Diplomystes papillosus*, Cuv. The family *Hypophthalmidæ*, with the genera *Hypophthalmus* and *Helogenes*, is confined to the northern Amazon and Guiana. The *Pygidiidæ* contain eleven genera, and are found in mountain-streams of Chili and the Argentine Republic. The *Argiidæ*, the anatomy of which needs further study, have only three genera. They are characteristic of the Andes of Peru, Ecuador, and Colombia. The *Loricariidæ*, with twenty-four genera, occur east from the Argentine Republic to Central America, west in Ecuador and Colombia. The seven genera of the *Callichthyidæ* extend from La Plata to Rio Orinoco, and in the Amazon as far as Nauta.

The authors may be congratulated on this work, which will be of the greatest value to the student of fishes. Thanks are due to the California Academy of Sciences for publishing this work. It forms Volume I. of a new series of publications, called "Occasional Papers of the California Academy of Sciences."

AMONG THE PUBLISHERS.

"FROM Babel to Comparative Philology" is the title of a chapter in Dr. Andrew D. White's "Warfare of Science," which will open the January *Popular Science Monthly*. It gives the origin of the legend in regard to the great tower and the confusion of tongues, and also traces the early history of the belief that Hebrew was the only language spoken by God and men before Babel was undertaken. The second article in the great series on "The Development of American Industries since Columbus" will also appear in that number. The special topic is "Iron-Mills and Puddling-Furnaces," being a part of the general subject of iron and steel, which is being treated by Mr. William F. Durfee. Like the opening paper, it is copiously illustrated, and much more readable than the title would indicate. Professor Huxley has attacked the idea that the people who spoke Aryan were one distinct race. His discussion of this point will be printed in the *Popular*

Science Monthly for January and February, under the title "The Aryan Question and Prehistoric Man." The storage of electricity will be explained in a fully illustrated article by Professor Samuel Sheldon of the Brooklyn Polytechnic Institute, in the January number.

—The president of the Royal Geographical Society declared in 1889 that "the most salient event of the year has been the daring journey of Fridtjof Nansen and his little party of Norwegians and Lapps across the inland ice of Greenland." Dr. Nansen's fully illustrated account of his adventures and of his extraordinary success will be published shortly, both in London and New York, by the Longmans.

— The action of Congress in setting apart a reservation of California forest land considerably larger in extent than the State of Rhode Island furnishes a theme for the leading editorial in *Garden and Forest* for Dec. 3. Some of the other subjects discussed are "House Gardening in Cities;" "The Trees of Kansas;" "A Fatal Disease of the Cranberry;" notes on orchids, ferns, wild-flowers, and chrysanthemums; and seasonable counsel for all interested in trees and shrubs. The principal illustration is of a vase of chrysanthemums, which is an object-lesson in the decorative value of these favorite flowers.

— The American Academy of Political and Social Science at Philadelphia is doing a valuable work in publishing material of value to students of economics and politics. It is making a specialty just now of the railroad problem. The July number of its proceedings contained an account of the reform in railway passenger tariffs recently introduced into Hungary. The January number will contain an account of the system just introduced into Austria. The work of the academy is all the more valuable on account of its strictly scientific character. The organization takes no sides, but contents itself with an objective presentation of the facts relating to the subject.

—Among the matter which has recently appeared in the *American Naturalist*, and which is in preparation, the following titles may be mentioned: "The Evolution of Mind from a Neo-Lamarckian Standpoint," by Professor E. D. Cope; "The Effects of the Electric Current on Kemmler's Body," by Dr. E. C. Spitzka; "On the Languages and Lore of the Zuñi Pueblos," by Dr. J. W. Fewkes of Harvard University; "On a Family of Hermaphrodites," by Dr. Luce; "The Wild Buffalo of Mindoro," by Professor J. B. Steere; "The Physiological Effects of Special Feeding on Bees," by Professor A. J. Cooke of Michigan State Agricultural College; and "The Metamorphic Forms of the American Newt," by Professor Simon Gage of Cornell University.

— Messrs. Ticknor & Co. have secured the exclusive sale for America, and will publish, by arrangement with Mr. B. T. Batsford, the London publisher, a limited edition of "Architecture of the Renaissance in England," by J. Alfred Gotch and W. Talbot Brown. The first part will appear immediately, and the others at intervals of two or three months.

— Last week's number of *The Illustrated American* is styled the "Naval Number," because sixteen pages are dedicated to naval matters. "Where We build our War-Vessels" is a description of the New York Navy Yard, illustrated; and "Our Battle-Ships" describes and illustrates the new battle-ship designed for the Bureau of Construction at Washington, and the most formidable war-ships of the foreign powers. A portrait of Admiral David D. Porter serves as the frontispiece. The wonders of the Nile are continued in an illustrated article describing hundred-gated Thebes.

— Lieut. Willoughby Walke, instructor in charge of the United States Artillery School laboratory, has made a series of experiments with the object of determining the strength of various newly invented or patented explosives. The composition of these new explosives, says *Engineering*, differs much; but they have all one feature in common, viz., that their inventors all claim that

Publications received at Editor's Office, Nov. 24–Dec. 6.

BAKER, D. W. History of the Harvard College Observatory during the Period 1840–1890. Cambridge, Harvard University. 32 p. 8°.
BALDWIN, J. Harper's Sixth Reader. New York, Harper. 504 p. 12°. 90 cents.
BRACKETT, C. F., and others. Electricity in Daily Life. New York, Scribner. 288 p. 8°.
CAJORI, F. The Teaching and History of Mathematics in the United States. Washington, Government. 400 p. 8°.
CENTURY Dictionary, The. Vol. IV. M–P. New York, The Century Co. 1324 p. f°. $10.
COLLEGE Advance, The. Vol. i. No. 1. Winfield, Kan., E. H. Vaughan. 4 p. f°. 25 cents per year.
EDDY, H. T. Maximum Stresses under Concentrated Loads. New York, Van Nostrand. 100 p. 8°.
GILMAN, N. P. Industrial Partnership or Profit Sharing. Boston, G. H. Ellis. 18 p. 24°.
HARVARD COLLEGE, Annals of the Astronomical Observatory of. Vol. XXI. Part II. Investigations of the New England Meteorological Society in the Year 1889. Cambridge, W. H. Wheeler, Pr. 273 p. 4°.
——Same. Vol. XXX. Part I. Observations made at the Blue Hill Meteorological Observatory, Massachusetts, in the Year 1889. Cambridge, John Wilson & Son, Pr. 75 p. 4°.
HUDSON, H. N. The Ancient Mariner. Boston, Ginn. 21 p. 12°.
LANGE, Helene. Higher Education of Women in Europe. Tr. by L. R. Klemm, Ph.D. (International Education Series.) New York, Appleton. 186 p. 12°. $1.25.
MACAULAY'S Second Essay on the Earl of Chatham. With Notes and a Sketch of Macaulay's Life by D. H. M. Boston, Ginn. 91 p. 12°.
MCMILLAN, W. G. A Treatise on Electro-Metallurgy. London, Charles Griffin & Co.; Philadelphia, Lippincott. 387 p. 12°. $3.50.
MACOUN, J. Catalogue of Canadian Plants. Part V. Acrogens. Montreal, W. Foster Brown & Co. 428 p. 8°.
MODIGLIANI, E. Un Viaggio a Nias. Milan, Fratelli Treves. 726 p. 8°.
NICOLSON, F. W. P. Terenti Afri. Phormio. Boston, Ginn. 66 p. 12°. 30 cents.
PEARSON, W. H. List of Canadian Hepaticæ. Montreal, W. Foster Brown & Co. 31 p. 8°
PICKERING, E. C., and WENDELL, O. C. Results of Observations with the Meridian Photometer during the Years 1882–88. (Annals of the Astronomical Observatory of Harvard College. Vol. XXIV.) Cambridge, John Wilson & Son, Pr. 267 p. 4°
ROLFE, J. C. P. Terenti Afri. Heavton Timorvmenos. Boston, Ginn. 61 p. 12°. 30 cents.

their product is as powerful as dynamite. The principal difficulty in arranging the experiments was to decide in what way the strength of the explosives should be tested, as no method yet invented can be considered entirely satisfactory. Finally Lieut. Walke decided to use the Quinan pressure gauge. The instrument used consisted of a heavy block of wood upon which was bolted a cast-iron block. In this block four wrought-iron guides were twisted around the circumference of a circle four inches in diameter, and were connected by a ring at their outer ends. A steel plate was let into the block, and was flush with its upper surface. The piston, which rested on a plug of lead, was of tempered steel four inches in diameter and five inches long, and moved freely between the guides. It weighed twelve pounds and a quarter. On the top of this piston was a parabolic cavity to hold the charge of explosive. The shot, made of tempered steel, was four inches in diameter and ten inches long, weighing four pounds and a half. It was bored down its centre to receive a capped fuze. To operate the instrument, a plug or cylinder of lead was placed on the steel plate, and the piston lowered gently down on it. The charge of explosive being placed in the cavity, the shot was gently lowered upon the piston. On firing the charge, the shot is thrown out and the piston forced down on the lead plug, which it compresses, the amount of compression being a measure of the strength of the explosive. Twenty-seven explosives in all being tried, the results were compared with those obtained with a sample of nitroglycerine, the strength of which was reckoned as 100. The results placed explosive gelatine and bellhoffite first with a strength of 106.17; gun-cotton and dynamite had each a strength of over 80; emmensite, a new American explosive, one of nearly 78; bellite, one of 65 70; and melenite, the famous French explosive, which is not nearly so safe to handle as bellite, had a strength of only 50.82. The above figures are of course not absolute, but they, at any rate, show the order in which the various explosives come.

INDUSTRIAL NOTES.

A Model Electric-Light Plant.

IN April of last year the electric-light system of the Eureka Electric Light Company of this city, then known as the Loomis system, was illustrated and described in these columns. Since that time the progress of the Eureka Company has been steady, though not as rapid, perhaps, as that of its older and larger competitors. Lighting and power plants have been installed in many parts of the country, and many improvements, both mechanical and electrical, have been made in minor details of the apparatus.

One of the latest of the Eureka Company's installations is a five-hundred light plant in the Vanderbilt Building, a large office building on Nassau Street, this city. The dynamo, of five-hundred-light capacity, is driven by a fifty-horse-power Fitchburg engine the Evans friction cone (also described in these columns some time ago) being used instead of belting, to transmit the power from engine to dynamo. This friction cone admits of a very compact arrangement of machinery, much less floor-space being required, as the engine and dynamo stand close together. This is an important consideration in modern office buildings, especially where space is valuable. The installation as a whole is one of the simpler and yet most complete, both electrically and mechanically, to be found in this city.

CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

Dec. 2.—Discussion on Arrows and Arrow-Makers; Robert Fletcher, Gambling-Sticks from Hupa Valley, California; Otis T. Mason, The Meeting of the American Folk-Lore Society.

Philosophical Society, Washington.

Dec. 6.—E. G. Fischer, On Standard Screws and Threads; Gilbert Thompson, An Example of Work in Barometric Hypsometry; B. E. Fernow, On the Artificial Production of Rainfall.

Appalachian Mountain Club, Boston.

Dec. 10.—Miss M. A. J. Frothingham, From the Gemmi to the Breithorn: H. H. Campbell, A Trip to the "Seven Ponds" in Maine (read by Mr. A. E. Scott).

Dec. 18 (special meeting).—Charles G. Van Brunt, An Ascent of Sierra Blanca, Col.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—An Exploring Expedition, backed by $15,000, will be sent into Alaska and the British Northwest Territory the coming year, to be gone one or two seasons. A scientist or two will more than likely be taken along. Applications from such will be gladly received and carefully considered. To assist in making these applications the commander would say that he considers a full practical knowledge of mineralogy and geology necessary, and if the applicant can add the duties of botanist, ethnologist, or any other of the sciences, and photography, sketching, medicine and surgery, or other useful arts for exploring, it will add to the chances of being selected. Applicants must be physically perfect, and ought to be about medium age. One of these scientists will be the second in command of the party. Any credentials forwarded for consideration will be returned, if requested, after consideration. Address "ALASKA," care of *Science.*

WANTED.—There being a considerable annual income for the purchase of books for the Museum Reference Library of Iowa College, it is desirable to have at hand any and all circulars, specimen sheets, catalogues, etc., of all works on Natural History in general, both foreign and domestic. Circulars of museum supplies, apparatus, etc., etc., desired also. State terms. Address ERWIN H. BARBOUR, Box 1333, Grinnell, Iowa.

WANTED.—A situation as Analytical Chemist is desired by the assistant of the late noted scientist, Dr. Cook, during his 15 years survey of the State of New Jersey Highest testimonials furnished. Address Prof. EDWIN H. BOGARDUS, New Brunswick, P. O. Box 224, care Prof. F. C. Van Dyck.

COULD some one inform me what the ingredients and origin of asphalt as used for street-paving and gathered at Trinidad are? Also how gathered and shipped by natives, and mode of refining by the Warren-Scharf Co. of New York and the Barber Co. of Washington? G. KNIPER, 28 Gunn Block, Grand Rapids, Mich.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I wish to exchange Eastern *Lepidoptera* for those that I do not have, particularly those found in the South. Jos. F. Crandall, Honesdale, Wayne Co., Pa.

To exchange, 1890 Seeger and Guernsey Cyclopedia, containing a complete list of the manufactures and products of the U. S., and address of first hands, cost $6. David R. Lewis, Saybrook, Ill.

For exchange—Nice specimens of Unios alatus, trigonus, parvus, occidens, anadontoides gibbosus, rectus, verucosus, gracilis coccineus, ventricasus, multiplicatus and plicatus cornutus. Margaritana confrogosa, complanata, rugosa. Anadonta edentula, decora, corpulenta, and about 300 of the beautiful Ana. suborbiculata. Wanted: Unios from all parts of the world, and sea-shells. Address Dr. W. S. Strode, Bernadotte, Ill.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

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INTRODUCTION OF THE ARTICULATING SYSTEM FOR THE DEAF IN AMERICA.[1]

WE are gathered to-day to celebrate the twenty-first anniversary of the opening of the Horace Mann School and the dedication of this building to its use. The many friends that surround us, the band of experienced teachers, the large number of pupils, this new and beautiful building, mark it as the day of our prosperity.

It seems fitting on this occasion to spend a few moments in recounting the causes that led to the establishment of this school, in showing what it has accomplished for the education of the deaf at home and abroad, and in recalling the memory of him through whose instrumentality it was founded.

This was the first public day-school ever opened to deaf children. Before this, they had been gathered into institutions apart from friends, isolated from the world around them, a distinct and separate community. This plan was thought necessary to their education. Our experiment, carried on for twenty-one years, has proved, by its continued and growing success, that to the deaf as well as to others all the advantages of school education can be extended without the severance of home and family ties. As the direct offspring of this the first day-school, similar schools have grown up in other States, and its influence is felt through the length and breadth of our land.

Have we not reason to be glad of the past, and take courage for the future? But this school represents not merely the opening of the first day-school, but, with the Clarke Institution, the introduction and development of a system of education for the deaf until then unknown in this country. Before that time the education of the deaf had been carried on by the sign-language. That this system had accomplished great and good results we gratefully acknowledge; but in our midst was growing up a distinct race, using a language of their own, unknown to their friends, without literature, and, though perhaps often beautiful and expressive, still vague and indefinite.

Perhaps but few who rejoice with us to-day can go back in memory to the time when, in doubt and anxiety, but with courage and hope, our little school was opened, and still further back to the introduction into this country of the oral system of deaf-mute education which this school has helped to develop.

Let us briefly review the history of deaf-mute education in this country from its commencement; and, if my narrative becomes somewhat personal, may I be excused. All great movements start from a small centre. Our broadest charities have grown from some individual human need. My own interest in the education of the deaf, and my earnest efforts to introduce what I believed a better method of instruction than the one then in use, sprang first from my anxiety for my little deaf child.

Early in the present century the parents and friends of a little deaf girl in Hartford, Conn., sought for her some means of education. There were no schools for the deaf in this country, and the Rev. Thomas Gallaudet was sent abroad to visit the various institutions in France and Germany, and study the methods of instruction. He brought back the French system of the Abbe de l'Epée. On inquiry, a number of deaf children were found, and the American Asylum at Hartford was incorporated. An appropriation was obtained from Congress and from each State from which pupils were sent. Other schools were opened in different States from time to time, and in all the sign-language was used.

Vague reports were occasionally brought to this country of another system, used in Germany, where the deaf were taught to speak and read from the lips. Nothing definite was known in regard to this system until 1843. In that year Mr. Horace Mann, then secretary of the Board of Education from Massachusetts, and Dr. Howe, went to Europe to study the various systems of education. They visited several schools for the deaf in Germany, and were surprised to find deaf children taught to speak and read from the lips. On their return, Mr. Mann published a report, and strongly advocated the adoption of the German oral system of instruction in this country.

His report excited such general interest, that the American Asylum and the New York Institution sent gentlemen abroad to investigate the subject. They reported that the sign-language was used in France, Italy, and Great Britain, and the oral system in Germany only; "that in the case of the great majority, instruction in mechanical articulation was attended by too little benefit to compensate for the serious efforts made in attempting it," and therefore no material change should be made in the American schools. A teacher of articulation was employed for a short time at the American Asylum; but the results were not satisfactory, and the system was abandoned. Earnest and devoted teachers labored faithfully to develop the mind and train the faculties through the medium of the sign-language. Much was accomplished, many a darkened mind was brightened, many lives enriched, many a saddened heart made glad; but the child was a foreigner in its own land, comprehending and using a language known only to the institution. It was taught to read and write the English language, but it remained always an unfamiliar tongue. The medium of instruction met the natural expression of its thoughts and feelings.

In 1860 my little girl lost her hearing through a fearful illness. She was a bright, intelligent child of four years, but her language was lisping and imperfect. When convinced of her deafness, our great anxiety was to retain her

[1] Address delivered by the Hon. Gardiner G. Hubbard at the twenty-first anniversary of the Horace Mann School, Boston, Mass.

language, and to know how we might carry on her education. We asked advice of one of the oldest teachers of the deaf. "You can do nothing," was the answer. "When she is ten years old, send her to the Institution, where she will be taught the sign-language."

"But she still speaks. Can we not retain her language?"

"She will lose it in three months, and become dumb as well as deaf. You cannot retain it."

It was in this time of our discouragement that we heard of the visit of Mr. Horace Mann and Dr. Howe to the schools of Germany, and their report in favor of the oral system. We turned to Dr. Howe for help. He told us that even children born deaf could be taught to speak, and encouraged us to talk to our little girl, and to teach her to recognize the spoken words of our lips. He warned us not to use nor to allow any signs, and never to understand them. Cheered by his encouragement, but discouraged by all other teachers of the deaf and by our own ignorance, we groped our way. Gradually light dawned. The child began to recall words forgotten in her long illness, and to add new words to her vocabulary learned from our lips. A young teacher, Miss True, who has ever since been devoted to the instruction of the deaf, but was then totally inexperienced, though admirably fitted by nature and training for the work, came to our aid. Our little girl joined her sisters in their lessons and their play. She knew no signs, she spoke imperfectly but intelligibly, and understood those around her. It was in after years that she told me she did not then know that she differed in any way from other children, and sometimes wondered why strangers would address her younger sister rather than herself. Meanwhile, under Miss True's intelligent teaching, her mental development progressed rapidly, and her language grew daily. We could not but feel that we had chosen the better system of education for our child, and earnestly wished other deaf children might share its advantages. We were confirmed in this opinion when, on a trip to Washington, we called with our little girl on Mr. Gallaudet and his mother, a deaf-mute. As she observed the child, and witnessed the readiness with which she understood and answered Mr. Gallaudet, she turned to her son and asked, "Why was not I taught to speak?"

In 1864, in connection with a few friends and aided by Dr. Howe, we applied to the Legislature for a charter for a school where the system of teaching articulation and lip-reading should be used. Hon. Lewis J. Dudley of Northampton, a member of the Senate and of the Committee on Education to which our petition was referred, had a daughter born deaf, then a pupil in the American Asylum. He was convinced from his own observation that it was impossible to teach the deaf to speak, and through his influence our efforts were defeated.

Not baffled nor discouraged by defeat, we then, with the aid and sympathy of a few friends, determined to open a little school of our own. After eight months of waiting for pupils, our school was opened at Chelmsford, in June, 1866, with only five pupils; but Miss Rogers was their teacher. Her sister had been with Dr. Howe as the teacher of Laura Bridgman and Oliver Caswell, both deaf, dumb, and blind from their birth. How identified Miss Rogers has been with the whole work from the very beginning, how much of its success is due to her earnestness and entire devotion, we all know.

Since the first days of that little school, teachers equally faithful, equally devoted, equally earnest, have entered into the work, and have carried it on to its present success; but Miss Rogers gave it its first start. Hon. Thomas Talbot, then lieutenant-governor, and brother-in-law of Miss Rogers, became interested in the work, and encouraged us to apply again to the Legislature. Mr. Talbot called with me on Gov. Bullock to secure his aid. To our great surprise and pleasure, the governor informed us that he had just learned that a gentleman in Northampton had been watching our work, and was ready to give fifty thousand dollars towards the endowment of a school for the deaf in Massachusetts, and that he would gladly help us.

In his annual address to the Legislature, in 1867, he said, "For successive years the deaf-mutes of the Commonwealth, through annual appropriations, have been placed for instruction and training in the asylum at Hartford. While, in the treatment of these unfortunates, science was at fault and methods were crude, in the absence of local provisions, this course was perhaps justifiable; but with added light of study and experience, which has explored the hidden ways and developed the mysterious laws by which the recesses of nature are reached, I cannot longer concur in the policy of expatriation, for I confess I share the sympathetic yearnings of the people of Massachusetts towards these children of the State detained by indissoluble chains in the domain of silence. This rigid grasp we may never relax; but over unseen waves, through the seemingly impassable gulf that separates them from their fellows, we may impart no small amount of abstract knowledge and moral culture. They are the wards of the State. Then, as ours is the responsibility, be ours also the grateful labor; and I know not to what supervision we may more safely intrust the delicate and intricate task than to the matured experience which has overcome the greater difficulty of blindness superadded to privation of speech and hearing. In no other object of philanthropy the warm heart of Massachusetts responds more promptly, assured as I am, on substantial grounds, that legislative action in this direction will develop rich sources of private beneficence. I have the honor to recommend that the initial steps be taken to provide for this class of dependants within our own Commonwealth," etc.

This portion of the message was referred to a large joint special committee, of which Mr. Dudley was chairman on the part of the House. Dr. Howe and Mr. F. B. Sanborn (the chairman and secretary of the Board of State Charities) appeared for that board; I represented petitioners for an act of incorporation; while Rev. Collins Stone (the principal of the American Asylum), Rev. W. W. Turner (its former principal), and Hon. Calvin Day (one of its vice-presidents) appeared in the interests of the asylum as advocates of the sign-language, and as opponents of our petition. A large number of deaf-mutes, with Professor D. E. Bartlett as interpreter, were also present. At one of the hearings my daughter was called before the committee, and questioned in arithmetic, history, and geography. Her answers were satisfactory.

To test her general intelligence, a gentleman asked, "Can you tell me who laid the first Atlantic cable?" Quickly and smilingly she answered, "Cyrus Field." The committee was convinced that her progress and intelligence were equal to that of most hearing children of the same age, and gave us our charter. At one of these hearings our little girl saw for the first time the deaf-mute's signs, and asked why deaf-mutes did not speak with the lips, as she did, for she thought it a great deal better to talk with the mouth than with the fingers.

Mr. Dudley became convinced of the superiority of the

oral system, and, with tears in his eyes, asked if his little daughter could ever be taught to speak. In a year he heard from her lips the words "father" and "mother."

Miss Rogers removed with her little school to Northampton, and became its principal. Thus the first school for teaching articulation, lip-reading, and oral instruction, was established in this country.

A member of the committee from Boston, also a member of the school committee of Boston, took an especial interest in the hearing. He attended every meeting, and visited our little school at Chelmsford, called repeatedly to see our daughter, and aided us by every means in his power to obtain our charter, having first inserted a provision giving us the right to establish schools in two other suitable places besides Northampton. The name of that gentleman was Dexter S. King. His interest in the education of deaf children, instead of ceasing with the granting of our charter, increased.

Scarcely was our school opened, when he asked that a branch might be started in Boston. This we were unable to do. Mr. King, as a member of the school board, secured the appointment of a committee to consider this subject in 1868 and 1879. The city was canvassed. Fifty deaf children were found, of whom only twenty-two were in school. Twenty-eight were at home, with no one able to render them aid in their search for an education. The committee established this school by the name of "The School for Deaf-Mutes." It was on Nov. 10, 1869, in a room in the old schoolhouse in East Street, with nine pupils. In one week an afternoon session had opened for eleven other pupils in the schoolhouse on Somerset Street. In January, 1870, it moved into suitable quarters on Pemberton Square, where it remained for several years.

When Mr. King retired from the school committee of the city of Boston, in 1871, a series of resolutions were passed,—"that to him was mainly due the project of establishing in this city a public school for deaf-mutes, the first institution of the kind in America,"—and expressing the thanks of the board for his valuable services.

For the remaining years of his life he was almost a daily visitor at the school. In the year 1873 the name of the school was changed to "The Horace Mann School." A principal was necessary who could not only instruct the deaf, but could supervise all the interests of the school, securing both the affection of the pupils and the confidence and respect of the school committee. To Miss Fuller this school and the deaf children of America owe a debt of gratitude that can never be repaid.

A few years later an English gentleman, Mr. B. St. John Ackers, visited the various schools of England and America, seeking for the best means of educating his own deaf child. He decided that she should be taught by articulation rather than by signs, which was the system then used in the English institution. He was so much pleased with this school, that he engaged one of its teachers, Miss Barton, to return with him. More and more convinced of the superiority of articulation teaching, and feeling the importance of thorough and earnest teachers, he was led to establish a normal school, which has sent out many teachers well fitted for their work. Subsequently Mr. Ackers, then a member of Parliament, was influential in securing the appointment of a royal commission to investigate and report upon the condition of the blind, the deaf, and the dumb of the United Kingdom, and was appointed one of the commission by the Queen.

Mr. Gallaudet and Professor Bell were invited to be present as representing the two systems in use in this country. Mr. Bell gave a full account of the Horace Mann School and its work, in which he has always felt the deepest interest. In their report the commission recommend "that every child who is deaf should have full opportunity of education in the oral system; that all children should be for the first year, at least, instructed in the oral system; and after the first year they should be taught to speak and lip-read on the oral system, unless they are physically deficient; that children who have partial hearing should in all cases be instructed in the pure oral system; that trained teachers of the deaf should, as in Germany, receive salaries such as would induce teachers of special attainments to enter the profession, and on a higher scale than those enjoyed by trained teachers of ordinary children."

In England as well as in our own country the influence of our work has been felt. The year before the Clarke Institution was opened, there were only 119 deaf children from the State at school. Now there are 312, an increase of 160 per cent, while our population has increased only 50 per cent.

Massachusetts has, therefore, more than three times as many pupils to-day in proportion to population as it had twenty years ago. Starting from Massachusetts as a centre, public interest was everywhere excited by the deaf. New institutions and day-schools were established in different parts of the country. In many of these the oral system alone was used. In all, teachers of articulation were employed, and articulation and lip reading made a part of their daily instruction. The number of pupils has increased from 3,246 in 1870, to 8,575 in 1890; and, in proportion to population, the ratio of increase equals that of our own State three to one. Who can doubt but that this is due to the influence of the Clarke and Horace Mann Schools, and to the general interest they have awakened in the education of the deaf?

Institutions for the deaf are undoubtedly necessary in every State, as children must be gathered from distant points; but wherever there are, in cities, a sufficient number of children, day-schools are certainly to be preferred. The home influence, the strong ties of affection, are often more important to the deaf child than to the hearing, for he is less prepared to fight the battle of life. The success of the Horace Mann School has led to the opening of day-schools in Portland, Providence, Cincinnati, Milwaukee, Chicago, St. Louis, Evansville, New Orleans, and La Crosse.

Let us here pause for a moment to pay a tribute of respect to the memory of one of the first and best teachers of this school. Early in its history Miss Bond became interested in it, and gave to it her time, her sympathies, and her earnest labors. For years her efforts for its progress were unwearied, and even in failing health and extreme physical suffering the welfare of the school was ever in her mind.

When we consider that the interest in deaf-mute education which formed the Royal Commission and the recommendations which have so changed the system of education in Great Britain is a direct growth from our work, have we not reason to believe that the seed sown in our weakness has already borne much fruit, and will yield a still more abundant harvest?

Believing that for the deaf our system lessens their privations, brings them more into communication with their friends and fellows, and, instead of building up still higher the separating wall of a different language, opens to them as to others the treasures of written language, shall we not rejoice that

it has been our privilege to work together for this end, and that out of the affliction of a little child a blessing has come to so many?

The success of our schools in which we rejoice to-day is due not only to the superiority of the oral system over the sign-language system, not only to the energy and perseverance of their founders, but, more than all, to the devotion, to the untiring zeal, and to the ability, of our teachers. No other teaching is so exacting, requires such constant attention and unwearied application.

The names of all are too numerous to mention. In our earthly as in our heavenly firmament one star differeth from another in glory, but bright as constellations shine the names of Miss Rogers, Miss Fuller, and Miss Bond.

This school is appropriately named the Horace Mann School, since Mr. Mann was the first to recommend the adoption of the oral system; but it was to Mr. King that this school owes its existence. The names of those who laid the foundation and built the edifice should not be forgotten.

But it is to Mr. King that this school owes its existence. A bronze tablet should be affixed to its walls; and associated with the name of Horace Mann should be the names of Dexter S. King and Sarah Fuller, inscribed thereon, that thus the names of the three who have done so much for the education of the deaf may be perpetuated.

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.[1]

An institution of learning may make a demand upon public recognition and gratitude because of its good work in training successive classes of young men for usefulness in life, even though it be not an innovator in education, and uses only the old and familiar methods of instruction; but it may acquire a further and larger claim by becoming a leader in its department, by introducing new methods, and opening the way to a better kind of intellectual and professional training.

How the Institute of Technology has dealt with the thousands of young men who have been its pupils since 1865, what it has done for them, what places they now occupy in the industrial system, what services they have rendered to the arts and industries of the country, common fame will tell. Those who would study this matter more carefully will find material in the lists of its graduates and of the places they fill, as told in the annual catalogues.

But in addition to its work in training a certain number of young men for the duties of life, the Institute of Technology has been pre-eminently a leader in education. Its influence has not been confined to what it has done for its own pupils, but has extended as far as its example of advanced scientific and technical instruction has gone.

Almost at the very outset a long step forward was taken in the establishment of a laboratory of general chemistry. Up to that time general chemistry had been taught wholly by means of text-books, or by lectures with experiments by the lecturer. The student's part was only to look and to listen, and learn in this way what he could. It was not until the student was put into the analytical laboratory, and took the retort into his own hand, that he did or discovered any thing for himself. Under the inspiration of Professor Rogers and the enterprise and administrative skill of Professor Charles W. Eliot and Professor Frank H. Storer, a laboratory of general chemistry was established, and the pupil from the first day of his chemical studies was set to teach himself. This was no analytical laboratory. It was simply designed as a means of illustrating, emphasizing, and supplementing the instruction of the lecture-room in regard to the nature of chemical action and the characteristics of the principal elements. The student was not told what he should find. He was told to do something, and note what occurred. He was thrown upon his own faculties of observation and reflection. He learned to know himself, and to measure his own power, and he acquired ease and accuracy of manipulation by practice. So far as known, this was the first laboratory of such a character set up in the world. Certainly it was the first one instituted in the United States for the instruction of considerable classes of pupils. The publication of "Eliot and Storer's Manual," designed for students taking this course, marked an epoch in the history of education.

Another equally important step in scientific education, and one of which the originality is beyond doubt, was taken at about this time in the establishment of a laboratory now known as the Rogers Laboratory of Physics. Under the inspiration of President Rogers, the scheme of a laboratory where the student of physics should be set to make observations and conduct measurements for himself, in demonstration and illustration of the physical laws taught in the lecture-room, was carried out with remarkable ability on both the scientific and administrative sides by Professor Edward C. Pickering, now director of the Harvard Observatory. So complete was Professor Pickering's study of the needs and capabilities of such a laboratory, so masterly his treatment of it, that it has required only more room and additional apparatus to allow the system he then devised and formulated to be extended successively to classes of fifty, of one hundred, and even of one hundred and fifty students.

In the school year of 1871–72 another forward step in education was taken at the Institute of Technology. Down to that time the instruction in mining engineering and metallurgy had been, here as elsewhere, conducted by means of text-books, lectures, drawing models, and assays of small pinches of ore, supplemented, in the case of the more fortunately situated schools, by occasional visits to mines in actual operation. In the year named a scientific expedition to the Rocky Mountains was undertaken by a large party of students and instructors from the institute. While in the Colorado mining regions, Professor Runkle conceived the idea of a laboratory which should add to the existing means of instruction in mining and metallurgy the practical treatment by the students of economic quantities of ores. This conception, so fully in the line of the general work of the institute, was given effect by the purchase in California, before the return of the expedition, of a number of pieces of apparatus suitable for the beginnings of such a laboratory. The apparatus thus obtained was set up by Mr. Robert H. Richards, then instructor, and now for many years professor, of mining engineering.

From these small beginnings made under Professor Richards's care it has grown steadily to this day. It was the first proper metallurgical laboratory devoted to the purposes of instruction in the world. It is under its title, "The John Cummings Laboratory," by far the largest and the best in the world to-day. Its graduates are found in the most important mines and smelting and reduction works of the

[1] From the Commemorative Address by Augustus Lowell, Esq., at the twenty-fifth anniversary of the Massachusetts Institute of Technology.

United States, showing the effect of their training at the institute, in which theory and practice were so happily combined, and in which every thing taught in the lecture-room is at once put to use in experiment and research.

In 1873 a further step in technical education led to the establishing of a laboratory of steam-engineering. An engine of sixteen horse-power was set up, and the necessary apparatus for engine and boiler tests was provided. Out of this humble beginning has grown the largest and best equipped mechanical engineering laboratory to be found, in which not only is the work of instruction carried further than ever before, but original research, conducted jointly by the students and their instructors, is pushed to points often beyond the range of ordinary expert investigation within the profession. In the same year the Lowell Free School of Industrial Design was established at the expense of the Lowell Institute, for the purpose of promoting the industries of the country, and especially the textile manufactures, by cultivating the American taste in respect to form and color.

In 1876 the system of shop-work as a means both of general and professional training was introduced. Half an acre of shops, filled with the best tools, machines, and engines, with over two hundred students pursuing this branch of instruction, represent to-day the poor, mean shed, with its scanty appliances, which was all that the funds at the command of the institute allowed to be erected in 1876.

In 1881 was established a laboratory of applied mechanics, devoted especially to the tests of building-materials in wood, stone, and iron. The equipment of the laboratory has been increased from year to year, until it comprises a great variety of apparatus and machines, designed largely by the instructors in that department, for making almost every kind of test which the purposes of the engineer, the architect, the ship-builder, or the mill-owner may require, — beam tests, column tests, belting tests, rope and wire tests, shafting tests, tests by tension, by transverse strain, by compression, by tensile strain, and continuous, intermittent, or instantaneous tests.

In 1884 the germ of a biological laboratory, which had existed in a corner of the shed used for the workshops of 1876, was developed with the aid of a large amount of physiological apparatus. The resources of the laboratory were turned, first, upon the preparation of its students for subsequent medical studies, and, secondly, upon bacteriological investigations, to which the marvellous discovery of Koch and Pasteur had pointed. It is not too much to say that there is scarcely a place in this country where as much important bacteriological work has been done during the past three years as in this laboratory of the institute.

In 1882 the increased demands upon the department of physics for the higher and more technical instruction of students, looking forward to electrical practice, led to the establishment of a distinct service devoted exclusively to that end, and, in connection with the new building of 1883, to the equipment of an electrical laboratory, with engine, dynamos, electric motors, and a great variety of electric testing apparatus. Notwithstanding this equipment, this course in electrical engineering, as it has been developed at the institute, could not be sustained but for the machinery and ample appliances of the engineering laboratories. The training of the electrical engineer at the Institute of Technology differs from that usually followed, in that the electrical engineer is here regarded as primarily a mechanical engineer, but a mechanical engineer who has specially studied the mechanical requirements of the electrical industries and enterprises, just as the chemical engineer under the course established two years ago is regarded in his relation to the chemical industries. And this introduces us to the last contribution made by the Institute of Technology to the philosophy of scientific and technical education, in the recognition of laboratory work in mechanics as an essential feature of a proper training in any branch of the great engineering profession. In the mechanical laboratories the students in each branch of engineering, civil, mechanical, mining, electrical, chemical, and sanitary, are called to perform the work of experiment, and to deal with the generation of power, and its application to the exigencies of their several contemplated professions.

We have thus roughly traced the history of the Institute of Technology. We have seen within how few years it has grown from a doubtful experiment into one of the most important schools of the country. We have seen how largely it has enjoyed the confidence and liberality of the public, and we feel that we may securely rely upon the same generous support hereafter. We have seen how its methods of instruction have been adapted to the changes and developments of practical science. We have seen that in this mobility, this power of adaptation, lay the grand idea of the whole scheme; and we are sure, that, so long as it continues to be its guiding principle, the Institute of Technology will stand, — a monument to the character, learning, and wisdom of its founder, worthy the community in which its establishment was possible and by which it has been maintained, an honor to the instructors who have devoted their energies to its service, and fortunate, as we trust it may long be, under the direction of so distinguished and able a president as Gen. Francis A. Walker.

HEALTH MATTERS.

The Influenza in Massachusetts.

THE secretary of the State Board of Health closes his annual report with the following facts about last winter's epidemic: "1. The first appearance of the influenza in Massachusetts as an epidemic, in the past season, may be stated to have been on Dec. 19 or 20, 1889, and the place of its first appearance was Boston and its immediate neighborhood. 2. It increased rapidly in the number of persons attacked, and reached its crisis generally throughout the State in the week ending Jan. 11, 1890, after which date it gradually declined in severity, and had nearly ceased as an epidemic by Feb. 10, so that the duration of the epidemic was about seven weeks. It reached its crisis earlier by several days in Boston than in the smaller cities and the remoter parts of the State. Its course was still later in Nantucket, Dukes, and Barnstable Counties. 3. The ratio of the population attacked was about forty per cent, or more exactly, as indicated by the returns, thirty-nine per cent, or about eight hundred and fifty thousand persons of all ages. 4. People of all ages were attacked, but the ratio of adults was greatest, of old people next, and of children and infants least. 5. The weight of testimony appears to favor the statement that persons of the male sex were attacked in greater number and with greater severity than females. 6. The average duration of the attack (acute stage) was from three to five days. 7. The predominant symptoms were mainly of three general groups, — nervous, catarrhal, and enteric, — the last being much less common than the others; the special symptoms much observed in the nervous group being extreme depression, pain, and weakness; in the catarrhal group, cough, dyspnœa, and coryza; and in the enteric group, nausea, vomiting, and diarrhœa. 8. The chief diseases which followed in the train of influenza, and were intimately associated with it, were bronchitis and pneumonia. Phthisis, when already existing in the victim of the attack, was undoubtedly aggravated, and in many cases a fatal termination was hastened. 9. The

ratio of persons attacked in industrial and other establishments employing large numbers was about thirty-five and a half per cent, or less than that of the population at large. That of the inmates of public institutions was still less,— twenty nine per cent. 10. The ratio of persons who were obliged to leave their work on account of illness from influenza was about twenty-seven per cent of the whole number employed. 11. The average length of their absence from work was five days. 12 Special occupations do not appear to have had a marked effect in modifying the severity of the epidemic upon operatives in such occupations. While the atmosphere may constitute one important medium of its communication, human intercourse also suggests itself as an equally important factor."

Fasting.

In connection with Professor Moleschott of Rome, Professor Luciani of Florence made a careful study of the "Hunger Virtuoso," Signor Succi, during his thirty-days' fast some two years ago. The results of their work are published in a monograph entitled "Fasting: Studies and Experiments upon Man," printed in Italian and German.

According to the *Medical Record*, Signor Succi, when not starved, is a man of strong muscular frame, with little subcutaneous fat, and weighing about one hundred and forty-seven pounds. During his thirty-days' fast in Italy he lost 6,161 grams, or about thirteen pounds During his first thirty days of fasting here he has lost considerably more. He drank at that time an average of 577.5 grams of water daily, which is about the amount he takes now.

Luciani states that he had "firm muscles, a good deposit of subcutaneous fat, a very slow tissue-change, and, above all, an extraordinary force of will." The Italian professor seems to think that by voluntary exertion Succi is able to slow down the metabolic processes, just as some peculiarly endowed persons can slow down the heart. It is upon this interesting point that Luciani particularly dwells; and he finds in Signor Succi a proof of the regulating influence of the nervous system over the functions of heat-production, respiration, hepatic action, etc.

How the Pathogenic Bacteria do their Harm.

Brieger and Fränkel have studied this question. Of course, the first condition for successful inquiry was to employ pure cultivations of the organism experimented upon. Basic bodies, denominated "toxine," had already been found in several pathogenic micro organisms, such as the bacillus of typhoid, tetanus, cholera, etc.; yet it was found that this toxine did not invariably call forth all the phenomena of the infectious diseases due to the bacilli, from pure cultivations of which it had been obtained: the supposition, therefore, seemed fair, that, besides the already found chemical bodies, there were other substances which played a momentous part (*The Edinburgh Medical Journal*). Brieger and Fränkel considered that Löffler's bacillus of diphtheria was well adapted for their purpose, because it is now beyond doubt that this organism is the genuine cause of diphtheria. Löffler had already called attention to the fact that this bacillus, when inoculated on animals,— guinea-pigs and pigeons,— colonized only the immediate neighborhood of the infected spot; yet grave alterations of texture and organs, and speedy death, of the animals experimented on, followed. This connection of events could only be explained in this way,— that the bacilli produced, by their local multiplication, a substance of exceedingly poisonous properties, which spread over the whole organism, and, independently of the bacteria did its deadly work. Brieger and Fränkel consider that they have proved that Löffler's diphtheria bacillus engenders in its pure cultivation a poisonous, soluble substance separable from the bacteria, which, when injected into susceptible animals, calls forth the same phenomena as the injection of the living micro-organism. The authors also have settled that this substance is destroyed by a heat of 140° F.; that it can stand a heat of 122° F., even in presence of excess of muriatic acid. This last fact of itself speaks against the supposition that the poison of the diphtheria bacillus is a ferment or an enzym. Further examination of this substance showed it was not a ptomaïne or toxine. No crystallizable substance, save kreatinin and cholin, was obtained. Shortly summing up their investigations, the authors seem to have discovered in the diphtheria bacillus a substance belonging to the albumen series of bodies, which has poisonous properties, and causes the phenomena of diphtheria when injected. They propose to give it the name of "toxalbumine." In the living body they consider that the bacteria build up and separate their toxalbumine from the albumen of the tissues. Brieger and Fränkel also examined typhoid, tetanus, and cholera bacteria, and staphylococcus aureus and watery extracts of the internal organs of animals killed by anthrax, in the same way as they had examined the diphtheria bacillus, and found in all of them bodies which, according to their chemical behavior, were albuminoids, were poisonous, and could therefore be aptly called toxalbumines. The road from normal constituents of the body to substances of the most dangerous kind seems a very short one, and our organism itself may be looked upon as the proximate cause of morbid conditions let loose by the life-activity of bacteria.

NOTES AND NEWS.

THE trustees of Johns Hopkins Unversity have decided to reopen the Marine Laboratory of the university in the coming spring. Further announcements will be made later.

— We learn from the London *Journal of Education*, that, according to returns compiled by the Civic Statistical Bureau of the schools of Munich, there were in 1889 in those schools 2,327 children suffering from defective sight; to wit, 996 boys and 1,331 girls. The gradual increase in the figures, which proceeds according to the distribution of the pupils into several classes, is highly significant. Of every 1,000 boys in the first or elementary class, 36 are short-sighted; in the second, 49; in the third, 70; in the fourth, 94; in the fifth, 108; in the sixth, 104; and in the seventh and last, 108. The number of short-sighted boys, therefore, from the first class to the seventh, increases about threefold. In the case of the girls the increase is from 37 to 119.

— Dr. Schmidt-Rimpler, the well-known Göttingen oculist, has been asked by the Cultusminister von Gossler to draw up a list of requirements for diminishing the shortsightedness so prevalent in German schools. Dr. Schmidt-Rimpler, according to the London *Journal of Education*, recommends (1) that teachers must acquire some knowledge of school hygiene; (2) that a medical attendant be attached to the school staff, and periodically inspect not only the school, but individual pupils; (3) that printed instructions be sent to the parents to inform them of the best position of the body for their children, especially with reference to writing, while engaged in the preparation of home-lessons; (4) that afternoon school be abolished, as far as is possible, so that the children may have plenty of exercise in fresh air; (5) that the amount of home-work be diminished, especially with regard to written tasks; (6) that the school course be not allowed to extend over too many years.

— The public lecture course of the New York Academy of Sciences for the season of 1890-91 is as follows: Nov. 24 "The Cliff Dwellings of the Mancos Cañons" (illustrated by projections of original photographs), by Mr. Frederick H. Chapin of Hartford, Conn.; Dec. 15, "Life and Scenes in the Hawaiian Islands" (illustrated), by Dr. H. Carrington Bolton of New York; Jan. 19, 1891, "Science and Miracle," by Professor A. J. Du Bois of Yale University, New Haven; Feb. 16, "Instantaneous Photography as an Aid to Science, History, and Art" (illustrated by novel lantern views), by Professor Wallace Goold Levison of Brooklyn, N.Y.; March 16, "The Orkneys and Shetlands" (illustrated), by Professor Charles Sprague Smith of Columbia College, New York; April 20, "Practical Applications of Electricity" (illustrated experimentally), by Francis B Crocker, E.M., of Columbia College; May 18. "What is a Diatom?" (illustrated,) by Charles F. Cox, M.A., of New York.

— W. T. Harris, United States commissioner of education, Washington, D.C., has issued a circular letter, dated Dec. 10, to presidents of colleges and universities in the United States, in which he says that it is assumed that language instruction in colleges and universities, so far as it relates to living tongues, is based on

the system of "visible speech" invented by Mr. Alexander Melville Bell, and that by its aid the pronunciation of a dialect can be conveyed in writing by one who has learned the sounds, to another person who has never heard the sounds, with reasonable accuracy. The object of this letter is to state that a rare opportunity is now presented to a limited number of higher educational institutions to avail themselves of the direct teaching of Mr. Bell through a lecture in elucidation of visible speech. All teachers of comparative philology understand this system, but perhaps can learn something in regard to the method of teaching it by seeing the method employed by Mr. Bell himself. It may be stated that the inventor of this system does not require any compensation for his lecture, but is willing to engage during the coming season, January to June, 1891, to give a free lecture on the subject named. Applications should be addressed to Mr. Alexander Melville Bell, 1525 Thirty-fifth Street, N.W., Washington, D C. Mr. Bell begs to state that for colleges, etc, near and to the south of the District of Columbia, early dates should be selected, and immediate application made, in order that visits may be serially arranged.

— The *Journal of Education* (London) is authority for the statement that Professors Ludwig, Wislicenus, Bruns, Bohm, Hoffmann, and Ostwald, all of the University of Leipzig, have signed the following declaration: "The undersigned, without as yet deciding what the course of instruction in the high-schools should be, nevertheless feel themselves compelled to declare that the education which our students have received in the Gymnasia, as at present constituted, is but little suited as a basis for the study of natural science and medicine." This has called forth the following counter-declaration, signed by one hundred and twenty-two Leipzig professors: "The undersigned professors and lecturers of the University of Leipzig declare that all educational reforms which do away with, or materially lessen, the study of the Greek language and literature, can only result in a serious injury to our national education. At the same time the undersigned express their conviction that the alterations, which may possibly be necessary in certain particulars, are quite possible with the retention of the classical basis of our Gymnasium education." Among the supporters of this declaration are the "Cultusminister" of Prussia, Bavaria, Saxony, Würtemberg, and Baden.

— Mr. Arthur Winslow, State geologist of Missouri, in his report of the operations of the State Geological Survey during the month of November, says that detailed mapping has been continued in Johnson, Madison, St. François, Washington, and Iron Counties, and about 170 square miles have been covered. In the laboratory analyses have been made of mineral waters collected during September and October, and work on a large number of clay samples has also been in progress. Examinations of clay deposits and building-stones have been made in Henry, Vernon, Bates, and Johnson Counties, and a number of specimens and samples have been collected for exhibition and test. For the purposes of the preliminary report upon the coal-deposits of the State, inspections have been extended into Miller, Morgan, Bates, Vernon, Dade, Cooper, Saline, and Audrain Counties. The field-work allotted to the past season is now very nearly completed, and during the month of December all members of the survey will be withdrawn from continuous field-work until next spring, and the intervening time will be devoted to preparing the results of the past season's work for publication.

— The board of directors of the National Educational Association, at the meeting held in St. Paul, indicated Saratoga Springs, N.Y., as their first choice, and Toronto, Canada, as their second choice, as the place of holding the next meeting of the association. The executive committee was instructed to make personal examination of railway facilities and local guaranties, and was empowered to make final decision as to time and place, and to complete arrangements for the next meeting. Three members of the committee visited Saratoga Springs. The local and State authorities gave guaranties beyond the requirements; but the Trunk Line Association, in whose territory Saratoga Springs is situated, refused to grant the customary reduced rates. The committee then opened negotiations with Toronto. Four members of the committee have visited that city and held consultations with the local and railroad authorities. Satisfactory guaranties have been presented by the local authorities and by the railroads with the exception of the Trunk Line Association. The next meeting of the association will be held at Toronto, Canada, July 14–17, 1891. The council will convene July 10. A cordial invitation, indorsed by the authorities of Ontario, of every province in Canada, and by the authorities of the Dominion, has been before the association for two years. Many of the teachers of Canada have become members of the association. They will meet in Toronto in full force, and will prepare an exhibit giving a complete view of Canadian systems of education.

— A patent has been issued this week to N. D. C. Hodges, editor of *Science*, for an improved method of protecting buildings from lightning. This invention is based on the large electrical capacity of a fine powder scattered in a dielectric. The electrical discharge is received on some body, which is then dissipated in the form of powder, and the potential of the charge is thereby largely reduced. The quantity of material which it is necessary to dissipate in order to furnish protection is not large if the material be placed so as to serve to the best advantage, at the most not exceeding a few cubic inches.

— In connection with the meeting of the National Electric Light Association in Providence, R.I., on Feb. 17, 18, and 19, 1891, it is proposed to hold an exhibition of electrical apparatus and appliances, especially such as are used in the business of furnishing light and power. A suitable hall has been secured opposite the hotel, which will be the association headquarters; and through the courtesy of the Narragansett Electric Lighting Company all the electric current necessary will be provided. There will be no charge for space or current to exhibiters, who must, however, be associate members of the association. The installation and care of exhibits will, of course, be at the expense of exhibiters. As this meeting may be said to virtually mark the close of the first decade of electric lighting commercially, it is suggested, that, as far as possible, efforts be made to show the progress in the art by exhibiting the earlier forms of apparatus and appliances, together with those embodying the latest improvements. The exhibition will open on Tuesday, Feb. 17, and close on Thursday evening, Feb. 19, and will be open day and evening. Exhibits may be installed on the Saturday and Monday previous, and removed on the following Friday. It is expected that this exhibition will prove very attractive to the Providence public, as well as to the members of the association. To exclude the street-gamin element, a nominal admission fee (twenty five cents) will be charged; but it is intended to circulate complimentary invitations freely among the representative business-men of the city, and exhibiters will be supplied with as many complimentary tickets as they may desire to distribute. As space is limited, and will be allotted in the order in which applications are received, it is desirable that all intending exhibiters apply to the chairman of the committee, C. H. Barney, 20 Cortlandt Street, New York, prior to Jan. 15, 1891, at which date all allotments of space will be made.

— The Copley Medal of the Royal Society, London, has been awarded to Professor Simon Newcomb of Johns Hopkins University, and superintendent of the "Nautical Almanac," for his contributions to gravitational astronomy. The medal was first given by the society in 1753, to Dr. Benjamin Franklin. In the following list the names are recorded of those who have received this honor during the last thirty years: 1860, R. W. Bunsen; 1861, L. Agassiz; 1862, T. Graham; 1863, A. Sedgwick; 1864, C. Darwin; 1865, M. Chasles; 1866, J. Plücker; 1867, K. E. von Baer; 1868, C. Wheatstone; 1869, H. V. Regnault; 1870, J. R. Joule: 1871, J. R. Mayer; 1872, F. Wöhler; 1873, H. L. F. Helmholtz; 1874, L. Pasteur; 1875, A. W. Hofmann; 1876, C. Bernard; 1877, J. D. Dana; 1878, J. B. Boussingault; 1879, R. J. E. Clausius; 1880, J. J. Sylvester; 1881, K. A. Würtz; 1882, A. Cayley; 1883, William Thomson; 1884, C. Ludwig; 1885, A. Kekulé; 1886, F. E. Neumann; 1887, J. D. Hooker; 1888, T. H. Huxley; 1889, G. Salmon; 1890, S. Newcomb. The mathematical medalists in previous years have been, Waring (1784), Ivory (1814), Gauss (1838), Sturm (1841), Chasles (1865), Plücker (1866), Sylvester (1880), Cayley (1882), Thomson (1883), Salmon (1889).

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

Vol. XVI. NEW YORK, December 19, 1890. No. 411.

CONTENTS:

UNIVERSITY AND SCHOOL EXTENSION.

The design of the University and School Extension recently started in this city is to supplement the university and the school systems by means of outlines for courses of study, class instruction, courses of lectures, correspondence, examinations, etc. The executive committee of the faculty consists of President Timothy Dwight, president of Yale University; Francis L. Patton, president of Princeton University; Seth Low, president of Columbia College; N. A. Calkins, superintendent of school extension; W. T. Harris, United States commissioner of education; Seth T. Stewart, general secretary. The officers of the board of directors are, president, James W. Alexander (Princeton); vice-presidents, Chauncey M. Depew (Yale), Charles S. Fairchild (Harvard), W. Bayard Cutting (Columbia); treasurer, George Foster Peabody (16 and 18 Broad Street, New York City); secretary, Matthew J. Elgas (121 West 87th Street, New York City).

The purpose is to develop a taste for further education and broader culture among those who, from necessity, have been debarred from some of the advantages of college or academic training, and to provide the skilful guidance of college professors and other experts in the study of the various subjects common to school and to university education The courses of instruction will be marked out by carefully prepared syllabuses, with directions as to what is most essential to the subject.

Individual students can be graded in lines of study and investigation; and plans are provided for securing the interest, sympathy, and mutual help that come through class instruction and lectures. Teachers and others associated in small or large classes may be guided in their studies, or they may enjoy the presence and advice of an approved class instructor in their chosen subject. In this way societies organized for the study of any language or department of history or science can be provided with reliable guidance and competent instruction. The classes will be formed for day or evening, at hours and places to suit the convenience of the class. Individuals or classes may also have the benefit of instruction by correspondence.

Syllabuses have been prepared by the professors named in connection with the following subjects, and others are now in the process of publication: German (four years), Professor H. H. Boyesen, Columbia; French (four years); Latin (four years), Professor Tracy Peck, Yale; Greek (three years), Professor T. D. Seymour, Yale; English literature of the seventeenth, eighteenth, and nineteenth centuries, Professor F. J. Child, Harvard; Shakspeare and Chaucer, George Lyman Kittredge, Harvard; American history to 1789, American history from 1789, European history from 1600 to 1750, European history from 1750, Professor S. M. Macvane, Harvard; law (two years), Professor Theodore Dwight, Columbia; physical geography (first and second years), Professor William Libbey, jun., Princeton; geology, Professor N. S. Shaler, Harvard; physics, Professor C. F. Brackett, Princeton; chemistry (two years), Professor William G. Mixter, Yale; astronomy, Professor C. A. Young, Princeton; elements of zoölogy, Alpheus Hyatt; political science, Professor John W. Burgess, Columbia; descriptive psychology and physiological psychology, Professor George T. Ladd, Yale; philosophy of education, N. A Calkins; plane and solid geometry, plane trigonometry, and spherical trigonometry, Professor A. W. Phillips, Yale.

The registration fee of one dollar entitles each registered student to one syllabus, one book-list with prices, the privilege of purchasing the books through the general secretary at list or wholesale prices, and an examination-paper in any one of the subjects in which an examination is held. It also entitles members to receive information as to the formation of classes, and to register for correspondence classes and for examination; but the correspondence fee of ten dollars, or the examination fee of two dollars, will be required before said correspondence or examination begins. Additional syllabuses may be had at twenty cents each, or six for a dollar.

Societies guaranteeing minimum charge for course of lessons or lectures will be accommodated as to time, place, and choice of instructor or lecturer. Ladies and gentlemen desiring to become patrons of a special subject of learning may organize auxiliary societies under a prescribed constitution, involving an annual membership fee of ten dollars per share. Any one desiring to promote the work among any class of people may assist in organizing them under constitutions involving membership fees of five dollars per share, or of one dollar per share, covering registration fee, the latter requiring extra charge for work done. A few general courses of lectures will be announced in New York City this year; but other courses will be given if a sufficient number register for the same in any chosen subject. The registration fee of one dollar will hold good until the member in any place shall have had an opportunity to attend class instruction or lectures in some one subject, or to receive correspondence instruction or lectures in a desired subject. Thereafter the fee will be an annual fee.

The registration fee should be sent to the general secretary, or in New York City to Matthew J. Elgas, secretary, 121 West 87th Street. Persons interested in the formation of classes, or lecture courses, or auxiliary societies, will be provided with the necessary forms and information on applying, with stamp enclosed, to Seth T. Stewart, general secretary, P. O. Box 192, Brooklyn, N.Y.

LETTERS TO THE EDITOR.

Dr. Hann's Studies on Cyclones and Anticyclones.

Under this heading appeared in *Science*, May 30 of this year, a notice, by Professor W. M. Davis of Harvard College, of a memoir by Dr. Hann of Vienna on "The High-Pressure Area of November, 1889, in Central Europe," etc., which has been recently

published. This notice itself requires a notice here, inasmuch as it aims a blow, not only at all recent advancement in cyclonology, but even at its very foundation in Espy's condensation theory. This notice has been long delayed from a desire to first see, and to reply to, Dr. Hann's memoir, which could not be found either in Washington or Boston. In this memoir, as the reader has been advised, Dr. Hann takes a new position with regard to the origin of cyclones; namely, that they depend upon the same forces, arising from the difference of temperature between the equatorial and polar regions, upon which the general circulation does, and that they are therefore simply subordinate parts of this circulation, and independent of any local causes. Professor Davis seems to have fallen in at first sight, as it were, with this new hypothesis, and says, "Having frequently advocated the sufficiency of the convectional theory of cyclones, I now make haste to place Dr. Hann's observations before the readers of *Science*, that they may see how clearly a revision of opinion is called for."

The great facility with which Professor Davis, apparently, can at once change his views on an intricate and perplexing scientific subject, which has puzzled profound thinkers, and his haste to forsake his former teaching and to rush into print to acknowledge his past errors, and, with the usual zeal of a new convert, to proclaim the newly adopted faith, seems very remarkable; so much so, that a suspicion arises that a little supposed high authority in high position has had more to do in the matter than a profound study of physical and mechanical principles. Dr. Hann's memoir was read before the Vienna Academy on April 17, was printed and received in this country by Professor Davis, and his notice of it appeared in *Science* of May 30: so it is seen how sudden the transition must have been.

So far, we merely have Dr. Hann's annunciation of the new hypothesis, without any attempt to form a theory from it by showing in what way the forces which give rise to the general circulation, and which act in two directions only,—toward the poles above, and the reverse in the lower part of the atmosphere,—can be brought to bear so as to give rise to the subordinate cyclonic disturbances, and to follow them up in their progressive motions so as to keep up the gyrations. A mere hypothesis, if it is a reasonable one, may be very useful as a basis of work or research of any kind, but in itself it proves nothing. If a plausible theory can be built up from the new hypothesis: if it can be shown how, from the general motions of the atmosphere, or the forces upon which they depend, a couple of forces can arise, necessary to give rise to a cyclonic motion, and then how this couple of forces follows after the cyclone to keep it in motion, as the boy with his trundling stick follows after his hoop, and gives it well-directed blows, always in the proper direction; why this couple of forces always tends to give a gyration in one way only in the northern hemisphere, and the contrary in the southern hemisphere; why the air in the cyclone always ascends and never descends; and so on,—very well. We will wait for this to be done. All this has been done in the condensation theory of cyclones, with results so satisfactory as to scarcely leave a doubt as to the truth of the whole theory; and we have a right to claim that as much should be done upon the new hypothesis, before it can be accepted.

Espy had a cast of mind which was not satisfied with vague general assertions, such as that cyclones are caused by the meeting of counter-currents of the air, and that they are continued, and all the powerful mechanical effects are produced, without the expenditure of any energy. And so, in seeking a source of energy, the happy thought occurred to him that this is to be found in the latent heat given out in the condensation of aqueous vapor in the interior of a cyclone, where there is always more or less rainfall. As the air, charged with vapor, is drawn in from all sides below and ascends, the vapor is condensed, and the latent heat given out keeps the ascending air warmer and lighter than the surrounding air. This accounts very satisfactorily for the ascent of air in the interior; and the energy by which the ascent of air and the whole vertical circulation is maintained is laid up in store in the lower part of the atmosphere, through which the cyclone passes, and is not found in the upper poleward-moving currents, as Dr. Hann says, from which there is no imaginable way in which it can be brought down and applied to the cyclone in the lower part of the atmosphere.

The air, being drawn in from all sides below, is pressed toward the right in the northern hemisphere, as is well known, by the deflecting force of the earth's rotation; and so there is a couple of forces, all around, acting in one direction on the one side, and the contrary on the other, which originates and maintains the gyratory movement; but the energy spent is all in the latent heat set free, and the deflecting force simply modifies the directions of motion. This accounts also, not only for the gyratory motion, but also for its being always in the same way in the same hemisphere. This very beautiful and satisfactory theory, so briefly sketched here, Professor Davis would have us give up for the merely vague general hypothesis that all depends upon the general circulation, without its having been shown how any of the motions of the cyclone, as accounted for above, can be accounted for upon this new hypothesis.

But of this theory Professor Davis says, it "is merely a local application of a theory that is universally accepted to account for the general circulation of the atmosphere between equator and poles; but the tests now furnished by high-level observations seem to show that the local application of the theory is incorrect." In the general circulation of the atmosphere the air rises in the equatorial regions where it is warmer and lighter, and sinks down in the polar regions where it is colder and heavier. But, according to Davis, the local application of this principle in the case of cyclones is not correct, but must be reversed; and the air in a cyclone rises in the interior where it is colder and heavier, and sinks down where it is warmer and lighter, and this is shown by the tests of high-level observations referred to. It is proposed, now, to examine some of these tests.

One of these high-level tests is found in the temperature observations made at numerous low and high stations among the Alps on Oct. 1, 1889. These gave a temperature of about 4° C., on the average, lower than that of a three-years' normal, for all the stations ranging in altitude from a few hundred metres up to 3,100 metres. The argument in this case seems to be this: these temperatures are 4° below the three-years' normal; therefore the condensation theory is not a correct theory. In drawing this conclusion, no consideration whatever seems to have been given to the question of what the real requirements of the condensation theory are, and at least two false assumptions have to be made. In the first place, it is assumed that surface temperatures in a cyclone must be above those of the three-years' normal, whereas the conditions of a cyclone have nothing to do with a three-years' normal or any other normal. It is simply required that the temperature of the air in general, over an area of several hundred miles in diameter in the interior of a cyclone, shall be higher than that of the air generally around and outside of this area at the time of the occurrence of a cyclone, so that the heavier air around the cyclone shall force the interior air up, and cause an ascending current. And it is not necessary that even this condition be fulfilled at the earth's surface and at all altitudes, but simply through a certain range of altitude; and this may be, and generally is, up in the cloud regions far above the earth's surface. Say the air below, for a mile or two up, had a lower temperature than the surroundings, but that the necessary cyclone conditions existed above this: thus a vertical circulation and a whirl in the air would take place above, which would diminish the pressure below in the interior, and increase it around about, so that in this way the air below, although having a lower temperature than the surroundings, would be brought into the vertical circulation and cyclonic gyration both by the change in the pressure conditions and by the action of the air above upon it through friction. Of course, in such a case the motions of this lower air would be at the expense of the energy above, and so the whole cyclonic system of motion would not be of a violent character. This seems to have been the character of the cyclone under consideration. There was only a very moderate barometric depression over a large area, the minimum pressure being 752 millimetres, the winds were gentle, and there was some rain and snow. If, therefore, the observed temperatures had even been 4° lower than the surrounding temperatures at the same level at a distance of several hundred

miles in all directions, instead of 4° below the three-years' normal, no conclusive argument could be drawn from it. But it is well known that the temperature departures from the normals are often very great and of long continuance. The observed temperatures, therefore, on Oct. 1, may have been 4° C. below the normal, and yet 5° or more above the surrounding temperatures at a great distance; and unless these surrounding temperatures are observed all around at distances of several hundred miles, and at almost all altitudes, or at least up three or four miles, so that there can be a comparison of the interior and exterior temperatures all around at the same levels, no argument can be deduced against the condensation theory of cyclones. In fact, it is readily seen from this that the theory can neither be proved nor disproved in this way, nor by a comparison of the interior temperatures with normals.

It is well known that surface temperatures, on the average, in cyclones, are generally below the normal temperatures, especially in the summer season. This is due, as Dr. Hann explained several years ago, to the products of condensation falling from high and cold altitudes. In Dr. Hann's memoir it is stated that on the day and evening preceding Oct. 1 rain fell in the valleys, and snow on the mountains. Now, it must be noted here that all the observations in the Alps on Oct. 1, from which the interior temperature of the cyclone, up to an altitude of 3,100 metres, has been estimated, were surface temperatures, and consequently they were considerably lower than they otherwise would have been, from the effect of the recently fallen snow. They cannot, therefore, be assumed to be the same as open-air temperatures, even at a little distance on the same levels, and, much less, can they represent the general average of the great mass of air in the interior of the cyclone, of perhaps five or six hundred miles in diameter and up to a considerable altitude. Since this has been explained by Dr. Hann to be a mere surface effect, why now attempt to deduce an argument from it against the condensation theory?

Another false assumption in the preceding argument is, that cyclones occur in a normal state of the atmosphere; for, unless they do, it is not logical to compare the observed temperatures in a cyclone, in the average of many observations, with the normal, and, if found to be less, to infer that the temperatures in cyclones are less than in the surroundings generally. The normal state of the atmosphere is one of stability, whereas cyclones occur in an unstable state of the atmosphere, when the vertical temperature gradient is abnormally large, and so when the parts of the atmosphere on a level with the upper part of the cyclone has a lower temperature than usual in reference to the temperature of the lower part; or, in other words, the average temperatures of the air at considerable altitudes, taken when the air is in an unstable state, and so when the conditions are favorable for cyclones, must be less than the general average of all times. The observed temperatures, therefore, in a cyclone at high-level stations, may be lower on the average of many observations, and yet higher than the average surrounding temperatures at the times of the cyclones, for these are below the normal on the average at these times. The observed negative temperature departures from the normal on Oct. 1, 1889, at the high stations in the Alps, may have been due to the fact that the air at the high levels at the time, both in and around the cyclone, had a temperature considerably below the normal on account of the abnormal and unstable state of the atmosphere at the time: and so on this account the observed temperatures may have been lower than the normal, and yet above the temperature of the surroundings; and so the necessary conditions of a cyclone would still have been fulfilled. The negative temperature departures on Oct. 1 were mostly at the higher stations.

Another of the high-level tests is the observed high temperature at elevated stations at the times of long-continued high barometric pressures, and especially that of the high-pressure area of November, 1889, over the Alps, which continued fourteen days. It is well known that in such cases there is a body of abnormally heated air at some distance above the earth's surface, of a foehnlike character, arising from the downward current which must necessarily exist in the high-pressure area. When the high pressure occurs over a mountainous region, such as that of the Alps, with high-level stations of observation, such abnormally high temperatures are frequently observed. Because these temperatures are frequently above the normal temperature of the month, or season of the year, and also sometimes found to be higher than the temperatures observed in cyclones at corresponding seasons, it is attempted to base an argument upon this against the condensation theory of cyclones. But what connection there is between the observed premise and the conclusion the writer is entirely unable to see. Whatever may have been the peculiar circumstances under which the long-continued high pressure existed, even if the temperature within had been raised 20° above the normal, he cannot see how this would interfere with the existence of the necessary conditions of a cyclone by the condensation theory, say in America, at the same time; and especially, it could have nothing to do with their existence at other times; and these long-continued high-pressure areas are not of frequent occurrence. These conditions, as is well known, are simply that the vertical temperature gradient at the time of the cyclone shall be greater than usual, so as to induce the unstable state in which the temperature of the air in the ascending current in the interior of the cyclone shall be kept, by the latent heat given out in the condensation of the aqueous vapor, a little above that of the surroundings, and so its specific gravity a little less. There is no reason why such conditions could not exist in America, or even anywhere at a considerable distance, during the time even of the existence of this peculiar state of pressure and temperature conditions over the Alps. It has never been claimed that the conditions of a cyclone exist in these high-pressure areas, and it is well known that the tendency is for cyclones to pass around such areas. Will Professor Davis be so good as to throw some light upon this dark part of the argument, so that there may be a clear understanding of it, and a thorough discussion of it at some other time?

Since by the new hypothesis the energy of cyclones is in the upper poleward-moving current of high latitudes, where the pressure gradients between the equator and the pole are steep, Professor Davis seems to realize the difficulty in applying this energy to the cyclones which originate below the tropics near the equator. He therefore thinks that a little of Espy's "steam-power" may be necessary at first until they get a start. During this time the energy is in the latent heat of the aqueous vapor, by which, set free in condensation, the ascending air is kept warmer and lighter than the surrounding air, and the gyration depends upon the deflecting tendency of the earth's rotation. But being once under way, this is changed, and the ascending air in the cyclone is colder and heavier than the surrounding air. At first it is compared with a train of cars, driven by its own store of energy; but after a time the engine becomes simply a dummy, and the train is driven by an external motor. But this is not strictly a happy comparison; for, instead of the engine becoming a dummy, it becomes a reversed engine. Before the change the ascending air was lighter than the surrounding air, and so the tendency was for it to rise, and for the cyclone to be continued; but after the change, when the ascending air was heavier, the tendency was just the reverse. Nevertheless the cyclone machine, after the reversal of the engine, seems to run on, all the same, and even with increased energy. Davis says the external motor is the general circulation of the winds. But why not say electricity? This would be just as satisfactory. It must be remembered here that the question is not with regard to the progressive motion of the cyclone, for there is no difficulty here, but with regard to the force which causes the heavier air to rise, and which maintains the gyratory motion. The mere assertion that these arise from the general circulation cannot be accepted in a scientific argument. Let it be proved, from true physical and mechanical principles, that there is a force arising from the general circulation which acts on all sides of the cyclone so as to force the heavier air up, and also acts as a couple in keeping up the gyration, or at least make it appear that this is probable; for unfortunately there are many things in science which cannot be absolutely proved, but only be made to appear reasonable and probable.

From what has been stated, it seems, that, of two rival theories, the one is applicable to the cyclone in the first part of its course, and the other in the latter part. But how is it with regard to tornadoes? Does the powerful ascent of air in these arise

from the unstable state in which the air in ascending becomes lighter than the surrounding air as it rises, or is it heavier in this case also, and has to be pushed up, as in the case of cyclones, by some external centripetal force on all sides at the base, originating in the steep gradients of the upper part of the atmosphere in high latitudes? for it must be remembered that by the new theory cyclones originate here. If the former, as is admitted in the case of tropical cyclones, then it is evident that the unstable state of the air can take place; and, if so, why can it not exist in the case of cyclones, in America at least, notwithstanding that the temperature of the air over the Alps, under some peculiar circumstances, sometimes becomes greater than the normal temperature, and than the mere surface temperatures on the Alps in a cyclone immediately after a recent fall of snow? As Professor Davis is the first one in America to adopt the new theory, if it can be so called, he must be regarded as its exponent here, and so feel bound to answer all pertinent questions and to give all necessary explanations; for it is to be presumed, that, during the two or three weeks of the transition period, he thoroughly studied it in all its bearings and applications. WM. FERREL.

Martinsburg, W.Va., Dec. 12.

BOOK-REVIEWS.

Electricity in Daily Life. New York, Scribner. 8°. $3.

FROM whatever point of view this book may be regarded, the effect cannot fail to be satisfactory. The expert electrician will find in it a succinct yet comprehensive survey of the whole field of electrical progress, from the earliest experiments down to the latest applications, with invaluable data made readily available by a copious index; the student will find it a guide to the particular branch of the science he may be specially interested in; and the general reader will find in it all that he may desire in the way of general information upon a subject comparatively new, fascinating in itself, and the results of which he is forced into contact with at almost every turn.

The volume is the joint production of Cyrus F. Brackett, Franklin L. Pope, Joseph Wetzler, Professor Morton, Charles L. Buckingham, Herbert L. Webb, W. S. Hughes, John Millis, A. E. Kennelly, and M. Allen Starr, M.D., each an authority on the special branch of which he treats. The publishers have done their part handsomely, the illustrations and typography being excellent, and the general make-up and finish of the volume setting off to the best advantage the work of its several writers. Even in the embellishment of the cover the artists have drawn their inspiration from the text, the ornamentation being worked up from fragments of telegraphic messages as recorded by the Morse instrument and the siphon recorder, and as prepared on a perforated ribbon for transmission by the Wheatstone instrument, together with artistic groupings of incandescent lamps and cables in outline and section.

In the opening chapter Mr. C. F. Brackett, professor of physics in Princeton College, briefly surveys the whole field of electrical science, tracing its history, explaining its technicalities, and making clear the principles involved in the use of conductors and insulators, and in the construction and operation of galvanometers, electro-magnets, dynamos and motors, transformers, and storage-batteries. In the second chapter Mr. Pope, past president of the American Institute of Electrical Engineers, treats of the electric motor and its applications, giving some account of every thing of importance in that department, beginning with Faraday's first motor, touching on the experiments of Ampère and Arago, Professors Henry and Jacobi, Dr. Page, and others, and going into greater detail on the evolution of the dynamos and motors of to-day. Joseph Wetzler of the *Electrical Engineer* makes an interesting chapter on the electric railway, explaining the three methods of applying the current to the railway motor, — the overhead-wire system, the underground-conduit system, and the storage-battery system; besides which he recounts the many advantages claimed for electrical over other roads, shows the comparative cost of construction, gives some electric-railway statistics for the United States, and points out the possibilities of the future in that direction. Electricity in lighting is ably treated by President Morton of the Stevens Institute, who touches all the salient points of that application of electrical energy, from Sir Humphry Davy's first electric light in 1808, down to the present time, when, as he states on p. 123, the daily output of incandescent electric lamps in this country alone is fifteen thousand, or at the rate of four million and a half lamps a year.

In the succeeding chapters the electric telegraph is treated of by Charles L. Buckingham of the Western Union Telegraph Company; the making and laying of submarine and other cables, by Herbert Laws Webb of the Metropolitan Telephone Company; electricity in naval and land warfare, by Lieut. Hughes of the navy, and Lieut. Millis of the army, respectively; electricity in the household, by Electrician Kennelly of Edison's laboratory; and electricity in relation to the human body, by M. Allen Starr, M.D., professor of nervous diseases in the College of Physicians and Surgeons of New York.

AMONG THE PUBLISHERS.

THE Christmas number of the American edition of the *Illustrated London News* contains three well-executed colored plates which have become a feature of a few of the largest weekly illustrated papers at the holiday season.

— Messrs. E. & F. N. Spon announce the following new books: "Electric Bell Construction: a Treatise on the Construction of Electric Bells, Indicators, and Similar Apparatus," by F. C. Allsop; "The Steam-Engine considered as a Thermo-dynamic Engine" (second edition, revised and enlarged), by J. H. Cotterill; "Smokeless Powder and its Influence on Gun Construction," by J. A. Longridge; "Modern Cotton-Spinning Machinery, its Principles and Construction," by J. Nasmith; and *The Journal of the Iron and Steel Institute*, No. 1, 1890.

—One of the most remarkable lists of famous contributors ever brought together in a single number of a magazine will be presented in the January issue of *The Ladies' Home Journal* of Philadelphia. The authors in that number will include Henry M. Stanley, Dr. Oliver Wendell Holmes, Ex-President Hayes, Hon. John Wanamaker, Joseph Jefferson, Hon. Hannibal Hamlin, Madame Albani, James Whitcomb Riley, Gen. Lew Wallace, George W. Childs, Dr. T. De Witt Talmage, Mrs. A. D. T. Whitney, Robert J. Burdette, Edward Bellamy, Will Carleton, Charles A. Dana, Sarah Orne Jewett, George W. Cable, Julian Hawthorne, Mrs. Lyman Abbott, Mrs. Margaret Bottome, and nearly twenty others.

—Messrs. Ginn & Co. announce to be published in February "Mechanism and Personality," by Francis A. Shoup, D.D., professor of analytical physics, University of the South. This book is an outline of philosophy in the light of the latest scientific research. It deals candidly and simply with the burning questions of the day, the object being to help the general reader and students of philosophy find their way to something like definite standing ground among the uncertainties of science and metaphysics. It begins with physiological psychology, treats of the development of the several modes of personality, passes on into metaphysics, and ends in ethics, following, in a general way, the thought of Lotze. It is strictly in line with the remark of Professor Huxley, that the reconciliation of physics and metaphysics lies in the acknowledgment of faults upon both sides, in the confession by physics that all the phenomena of nature are, in their ultimate analysis, known to us only as facts of consciousness, in the admission by metaphysics that the facts of consciousness are practically interpretable only by the methods and the formulæ of physics.

— The late Professor Austin Phelps had just previous to his death completed preparations for a new volume somewhat similar in character to his "My Study" and "My Portfolio." It is entitled "My Note Book," and is to be issued immediately by the Scribners. It contains a number of the author's briefer essays, with some detached thoughts, somewhat of the nature of table-talk. Professor A. L. Perry of Williams College, the well-known author of works on political economy, has just completed a new work entitled "Principles of Political Economy," which will also be

issued at an early date by the Scribners. Col. Church's "Life of Ericsson," issued by the same firm, went into a second edition almost immediately upon publication.

— Among the contents of the *New England Magazine* for December we note, "Emerson and his Friends in Concord," by Frank B. Sanborn; "What shall we do with the Millionnaires?" by Charles F. Dole; "Quebec," by Samuel M. Baylis; "Anti-Slavery Boston," by Archibald H. Grimké; "A Day in the Yosemite with a Kodak," by Samuel Douglass Dodge; "Making Man-o'-war's-men," by W. L. Luce; "Harvard's Better Self," by William Reed Bigelow; "On the Rappahannock," by Charles H. Tiffany; and "King Philip's War," by Caroline Christine Stecker.

— The "Papers of the American Historical Association" for October, just issued by G. P. Putnam's Sons, deal largely with the subject of historical documents and the importance of collecting and preserving them. The opening paper, by John O. Sumner, is on "Materials for the History of the Government of the Southern Confederacy," and gives an account of the difficulties the author met with in searching for such materials. Professor William P. Trent follows in a similar strain, complaining of the indifference shown by most Southerners to their local history. Both writers strongly insist on the importance of collecting the materials for Southern history before it is too late. Mr. William Henry Smith has a paper on "The Pelham Papers," in which he points out their importance for the history of New York in 1755–56. These various essays, together with some shorter ones that this number contains, show that the association is alive to the importance of collecting our historical records, and we trust that it will be successful in doing so. A circular letter from the association to the State historical societies asks for their co-operation in historical work, which will doubtless be gladly given. Besides the papers mentioned, the pamphlet before us contains several others on various themes, the longest and most elaborate being by Mr. William A. Dunning, on "The Impeachment of President Johnson," in which that celebrated case is treated with true historical impartiality. The remaining papers deal with the early history of Kentucky, the economic history of New England, the trial of John Brown, and other topics in American history; but none of them call for any special remark.

— The announcement is made that a new edition of "The Life of Our Lord," by Rev. S. J. Andrews, D.D., largely re-written and brought down to date in every respect, is now in press for early publication. It will be printed from new plates, and will contain a number of maps.

— On or before Jan. 1, 1891, will appear an illustrated magazine entitled the *Bacteriological World*, which will have for mission the general dissemination of knowledge on the subject of bacteriology in general, and pathological micology in particular. The first number will contain the following: frontispiece, Pasteur's and Koch's pictures; "Study of Bacteriology" (preface, introduction, etc.); "Generalities on Germs, Spontaneous Generation;" "Actinomycosis in Man and Beasts (Big Jaw of Cattle);" "Foreign and Home Investigations;" "Bacterial Complication of Wounds (Ogston, Rosenbach, Cornil, Babès, etc.);" "Immunity," by Dr. Bouchard, Paris, France; "Hydrophobia," by Dr. Paul Gibier, Pasteur's Institute, New York City; "True and Spurious Bovine Vaccination and Complications," by Paul Evans, Pathological Laboratory Missouri Agricultural Experiment Station; "Clinical Notes;" editorial; "Koch's Treatment of Tuberculosis;" and "Notes from Laboratories" (Pasteur's laboratory and others). All communications and articles, except those relating to advertisement and subscription, should be addressed to the editor, Paul Paquin, Columbia, Mo., U.S.A. All matters pertaining to advertisement and subscription should be addressed to The Bacteriological World Publishing Company, Columbia, Mo., U.S.A., or Dr. T. J. Turner, Mexico, Mo., U.S.A.

Publications received at Editor's Office, Dec. 8–13.

ADLER, C. Report on the Section of Oriental Antiquities in the U. S. National Museum, 1888. Washington, Government. 12 p. 8°.
BERTENSHAW, T. H. Longmans' French Course. London and New York, Longmans, Green, & Co. 208 p. 12°. 60 cents.
BIRD, C. Elementary Geology. London and New York, Longmans, Green, & Co. 248 p. 12°. 80 cents.
DAWSON, G. M. On the Later Physiographical Geology of the Rocky Mountain Region in Canada, with Special Reference to Changes in Elevation and the History of the Glacial Period. Ottawa, Roy. Soc. Can. 74 p. 4°.
GILL, T. Osteological Characteristics of the Family Amphipnoidæ. Washington, Government. 4 p. 8°.
GOODE, G. B. Report upon the Condition and Progress of the U. S. National Museum during the Year ending June 30, 1888. Washington, Government. 84 p. 8°.
HIPPISLEY, A. E. A Catalogue of the Hippisley Collection of Chinese Porcelains, with a Sketch of the History of Ceramic Art in China. Washington, Government. 105 p. 8°.
HJELT, E. Principles of General Organic Chemistry. Tr. by J. B. Tingle. London and New York. 220 p. 12°. $1.75.
HOUGH, W. Fire-making Apparatus in the United States National Museum. Washington, Government. 57 p. 8°.
JAGO, W. Inorganic Chemistry. London and New York, Longmans, Green, & Co. 458 p. 12°. $1.50.
LUCAS, F. A. The Expedition to the Funk Island, with Observations upon the History and Anatomy of the Great Auk. Washington, Government. 37 p. 8°.
MORRIS, I. H. Practical Plane and Solid Geometry, including Graphic Arithmetic. London and New York, Longmans, Green, & Co. 260 p. 12°. 80 cents.
SEAWELL, Molly Elliot. Little Jarvis. New York, Appleton. 64 p. 12°. $1.
VERÖFFENTLICHUNGEN aus dem Königlichen Museum für Völkerkunde. Band I. Heft 4. Berlin, W. Spemann. 72 p. f°.

— *Scribner* will begin an Australian edition with the January number, and a group of articles on that country will appear during the coming year. Josiah Royce of Harvard writes his "Impressions of Australia" in the January issue, and court-tennis, the oldest game of ball that we have, is described by Dr. James Dwight (ex-champion doubles at lawn-tennis). There are very few courts in this country, those at Boston, Newport, and New York being the chief.

— Henry M. Stanley, in his article on "African Pygmies," to appear in the January *Scribner*, says, "For the benefit of such of your readers as take an interest in pygmy humanity, I have taken the trouble to write this article, that they may have a little more considerateness for the undersized creatures inhabiting the Great Forest of Equatorial Africa. They must relieve their minds of the Darwinian theory, avoid coupling man with the ape, and banish all thoughts of the fictitious small-brained progenitor supposed to be existing somewhere on land unsubmerged since the eocene period. . . . Intellectually, the pygmies of the African forest are the equals of about fifty per cent of the modern inhabitants of any great American city of to-day; and yet there has been no change, or progress of any kind, among the pygmies of the forest since the time of Herodotus.

— A new departure has just been made in periodical literature in the form of a quarterly entitled *The Critical Review of Theological and Philosophical Literature*. It is edited by Professor S. D. F. Salmond of Edinburgh, and contains able reviews of all the notable new books in the fields indicated by the title, giving a chronicle of all publications in these departments, and noticing the more important articles in magazines and journals. The reviews will be the work of eminent writers, and will be signed. The quarterly is published by Messrs. T. & T. Clark of Edinburgh, and is controlled in this country by Messrs. Scribner & Welford. The first number, now ready, contains articles by Principal Rainy, Professor A. B. Davidson, Canon Driver, Professor A. B. Bruce, Professor Marcus Dods, Professor W. G. Blaikie, and other well-known authors.

— *The Political Science Quarterly* for December opens with a study of Henry C. Carey and his social system, by Professor C. H. Levermore. Brander Matthews contributes an article on "The Evolution of Copyright;" Professor Charles Gide of Montpellier, France, discusses the present condition of the study of political economy in France; Professor E. R. A. Seligman concludes his series of articles on "The Taxation of Corporations;" and Professor A. B. Hart gives a sketch of Herman von Holst, both in his private life and his literary career. In addition to these leading articles, the number contains reviews of more than twenty recent publications, with the regular semi-annual "Record of Political Events."

—"Harper's Sixth Reader," which has just been published by the American Book Company, completes the well-known series of school-readers edited by James Baldwin, Ph.D., and heretofore published by Harper & Brothers. The volume is made up wholly of selections from the works of British authors, prose and verse; so that, in schools where an early acquaintance with British writers is thought desirable, its study may be taken up at once upon the completion of the "Fourth Reader," its reading-lessons being of nearly the same grade as the "Fifth Reader" of the same series. Otherwise it may be used alternately with the latter volume, or as a sequel to it. The exercises are well selected and carefully graded, the lessons being so arranged that those requiring deeper thought and greater reading ability follow those which are easier. Among the selections are some of the acknowledged classics of the language, as might naturally be expected in a compilation of the kind. Notes, biographical and otherwise, at the end of the volume, will be found helpful and suggestive to both teacher and pupil

CALENDAR OF SOCIETIES.

Biological Society, Washington.

Dec. 13.—William Palmer, The Occurrence of an Asiatic Cuckoo on the Pribylov Islands; C. V. Riley, New Notes on the Genus Phylloxera; F. W. True, The Teeth of the Muskrat; F. A. Lucas, The Wing of Metopidius.

Boston Society of Natural History.

Dec. 17.—A. E. Dolbear, The Physics of Crystalline and Cellular Structure; T. T. Bouvé, Kame Ridges and Hillocks of Hingham.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—A young man wishes a position as instructor in the sciences in some school or college. Chemistry a specialty. Would like to hear of some position with a private or manufacturing chemist, in which his knowledge of chemistry would help him. Address E. E. TOWNE, B.A., 272 Worthington St., Springfield, Mass.

WANTED.—An Exploring Expedition, backed by $15,000, will be sent into Alaska and the British Northwest Territory the coming year, to be gone one or two seasons. A scientist or two will more than likely be taken along. Applications from such will be gladly received and carefully considered. To assist in making these applications the commander would say that he considers a full practical knowledge of mineralogy and geology necessary, and if the applicant can add the duties of botanist, ethnologist, or any other of the sciences, and photography, sketching, medicine and surgery, or other useful arts for exploring, it will add to the chances of being selected. Applicants must be physically perfect, and ought to be about medium age. One of these scientists will be the second in command of the party. Any credentials forwarded for consideration will be returned, if requested, after consideration. Address "ALASKA," care of *Science*.

WANTED.—There being a considerable annual income for the purchase of books for the Museum Reference Library of Iowa College, it is desirable to have at hand any and all circulars, specimen sheets, catalogues, etc., of all works on Natural History in general, both foreign and domestic. Circulars of museum supplies, apparatus, etc., etc., desired also. State terms. Address ERWIN H. BARBOUR, Box 1333, Grinnell, Iowa.

WANTED.—A situation as Analytical Chemist is desired by the assistant of the late noted scientist, Dr. Cook, during his 15 years survey of the State of New Jersey. Highest testimonials furnished. Address Prof. EDWIN H. BOGARDUS, New Brunswick, P. O. Box 224, care Prof. F. C. Van Dyck.

COULD some one inform me what the ingredients and origin of asphalt as used for street-paving and gathered at Trinidad are? Also how gathered and shipped by natives, and mode of refining by the Warren-Scharf Co. of New York and the Barber Co. of Washington? G. KNIPER, 28 Gunn Block, Grand Rapids, Mich.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I wish to exchange Eastern *Lepidoptera* for those that I do not have, particularly those found in the South. Jos. F. Crandall, Honesdale, Wayne Co., Pa.

To exchange, 1890 Seeger and Guernsey Cyclopedia, containing a complete list of the manufactures and products of the U. S., and address of first hands, cost $6. David R. Lewis, Saybrook, Ill.

For exchange—Nice specimens of Unios alatus, trigonus, parvus, occidens, anadontoides gibbosus, rectus, verucosus, gracilis coccineus, ventricasus, multiplicatus and plicatus cornutus. Margaritana confrogosa, complanata, rugosa. Anadonta edentula, decora, corpulenta, and about 300 of the beautiful Ana. suborbiculata. Wanted: Unios from all parts of the world, and sea-shells. Address Dr. W. S. Strode, Bernadotte, Ill.

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INFANT PSYCHOLOGY.

THE study of psychology has had so remarkable a development in recent years, and the standpoint from which it is now approached is so unlike the point of view of older writers on mental philosophy, that the several departments which it now comprises stand in need of separate introductions; and not only are such introductions necessary for purposes of exposition, but their apologetic function, though reduced to a minimum, is still real. The expression "nursery psychologist" no doubt means what its author intended it to mean to some others than himself; and it is desirable that it should be understood by the educated public as a badge of honorable service rather than as a phrase of disparagement and discredit.

No doubt we owe to the rise of the evolution idea something at least of the benefit brought about by what we may call the psychological renaissance of the last twenty-five or thirty years. The breadth of the current conception of psychology is certainly in harmony with the conceptions long ago current in other departments of scientific research; but there is a phase of this broadening of psychological inquiry strikingly brought out only when interpreted in the light of evolution doctrine. This is what we may call the genetic phase, the growth phase. The older idea of the soul was of a fixed substance, with fixed attributes. Knowledge of the soul was immediate in consciousness, and adequate; at least, as adequate as such knowledge could be made. The mind was best understood where best or most fully manifested.

Under such a conception, the man was father of the child. What the adult consciousness discovers in itself is true, and wherein the child lacks it falls short of the true stature of soul life. We must therefore, if we take account of the child-mind at all, interpret it up to the revelations of the man-mind. If the adult consciousness shows the presence of principles not observable in the child consciousness, we must suppose, nevertheless, that they are really present in the child consciousness beyond the reach of our observation. The old argument was this,—and it is not too old to be found in the metaphysics of to-day,—consciousness reveals certain great ideas as simple and original: consequently they must be so. If you do not find them in the child-mind, then you must wait for the child-mind to grow.

The genetic idea reverses all this. Instead of a fixed substance, we have the conception of a growing, developing activity. Instead of beginning with the most elaborate exhibition of this growth and development, we shall find most instruction in the simplest activity that is at the same time the same activity. Development is a process of involution as well as of evolution, and the elements are hidden under the forms of complexity which they build up. Are there principles in the adult consciousness which do not appear in the child consciousness? Then the adult consciousness must, if possible, be interpreted down to the child consciousness.

Now that this genetic conception has arrived, it is astonishing that it did not arrive sooner. The difference between description and explanation is as old as science itself. What chemist long remained satisfied with a description of the substances found in nature? He was no investigator at all, and his science was not born until he became an analyst. The student of philology is not content with a description, a grammar, of spoken languages: he desiderates their reduction to common vocal elements. But the mental-scientist has called such description science, even when he has had examples of nature's own furnishing around him which would have confirmed or denied the results of mental analysis.

The advantages which we look to infant psychology to furnish are covered by this need of analysis; and the reason that the needed analysis is found here, is that the mind, like all other natural things, grows. This general statement may be put into concrete form under several points, which divide this branch of general psychology from others now recognized.[1]

1. In the first place, the phenomena of the infant consciousness are simple as opposed to reflective; that is, they are the child's presentations or memories simply, not his own observations of them. In the adult consciousness the disturbing influences of inner observation is a matter of notorious moment. It is impossible for me to know exactly what I feel, for the apprehending of it through the attention alters its character. My volition also is a complex thing of alternatives, one of which is my personal pride and self-conscious egotism. But the child's emotion is as spontaneous as a spring The effects of it in the mental life come out in action, pure and uninfluenced by calculation and duplicity and adult reserve. There is around every one of us a web of convention and prejudice of our own making. Not only do we reflect the social formalities of our environment, and thus lose the distinguishing spontaneities of childhood, becoming in so far all coins of the same mint, but each one of us builds up his own little world of seclusion and formality with himself. We are subject not only to idols of the forum, but to idols also of the den.

The child, on the contrary, has not learned his own im-

[1] Race, animal, abnormal psychology, etc.

portance, his pedigree, his beauty, his social place, his religion, his paternal disgrace; and he has not observed himself through all these and countless other lenses of time, place, and circumstance. He has not yet turned himself into an idol nor the world into a temple; and we can study him apart from the complex accretions which are the later deposits of his self-consciousness.

Perhaps one of the best illustrations we can find of the value of this consideration in the study of the child-mind is seen in the reversion to the child-type occasioned by hypnotism. The signal service of hypnotism, I think, is the demonstration of the intrinsic motor force of an idea. Any idea tends at once, and irresistibly, to realize itself in action. All conventionalities, proprieties, alternatives, hesitations, are swept away, and the developed mind reveals its skeleton structure, so to speak, its composition from re-active elements. But hypnotism need not have been waited for to show this. The patient observation of the movements of a child during his first year would have put it among the safest generalizations of the science of mind. In the absence of alternative considerations, reflections, the child acts, and act it must, on the first suggestion which has the faintest meaning in terms of its feelings of movement.

2. The study of children is generally the only means of testing the truth of our mental analyses. If we decide that a certain complex product is due to a union of certain simpler mental elements, then we may appeal to the proper period of child-life to see it taking place. The range of growth is so enormous from the infant to the adult, and the beginnings of the child's mental life are so low in the scale in the matter of instinctive and mental endowment, that there is hardly a question of analysis now under debate which may not be tested by this method. On the other hand, such confirmation shuts out most conclusively the advocates of irreducibility in cases where the adult consciousness is silent or utters a favorable voice. A good example of such analysis is seen in the distinction between simple consciousness and self-consciousness. Over and over again have systems been built upon the necessary subject-object theory of consciousness; namely, that all subjectivity, or consciousness, necessarily implicates an antithesis between *ego* and *non-ego*. But an example of what is thus denied may be seen upon the floor of any nursery where there is a child less than a year of age.

At this point it is that child psychology is more valuable than the study of forms of the consciousness of animals. The latter never become men, while children do. In studying animals we are always haunted by the fear that the analogy may not hold; that some element essential to the development of the human mind may be entirely wanting. Even in such a question as the localization of the motor functions of the brain, where the analogy is one of comparative anatomy and only secondarily of psychology, the monkey presents analogies with man where dogs do not. But in the study of children we may be always sure that a normal child has in him the promise of a normal man.

The contrast between this branch of psychology and mental pathology also shows points of advantage on the side of the former. In the study of mental disease the mental function as a whole is or may be involved. We are never sure that functional connections and sympathies have not been developed in the growth of the personality as a whole, which lead to idiosyncrasies in that area of mental activity which seems to be most unaffected. For this reason the application of the logical "method of difference," which consists in observing the change brought about in a phenomenon from the removal of part of its antecedent conditions, cannot be always relied upon.

The same difficulty confronts the student of animal pathology. The indefinite source of error called "shock" is always present. The organs left intact by the disease or the operator sympathize in the sufferings of the organism as a whole; and sometimes temporary loss of function is reported, when time repairs the apparent damage.

In dealing with the child, however, the same advantage of simplicity is secured without the corresponding disadvantage of possible interference of functions. In other words, the simplicity of the child is normal simplicity, while the simplicity of disease or surgery is abnormal simplicity; and the danger of what physicians call "complication" is in the former case entirely ruled out.

3. Again, in the study of the child-mind, we have the added advantage of a corresponding simplicity on the organic side; that is, we are able to take account of the physiological processes at a time when they are relatively simple. I say "relatively simple," for in reality they are enormously complex at birth, and the embryologist pushes his research much further back in the life-history of the organism. But yet they are simple relatively to their complex condition after the formation of habits, motor complexes, brain integrations and associations; in short, after the nervous system has been educated to its whole duty in its living environment. For example: a psychology which holds that we have a "speech faculty," an original mental endowment which is incapable of further reduction, may appeal to the latest physiological research and find organic confirmation, at least as far as a determination of its cerebral apparatus is concerned; but such support for the position is wanting when we return to the brain of the infant. Not only do we fail to find the series of centres into which the organic basis of speech has been divided, but even those of them which we do find have not taken up the function, either alone or together, which they perform when speech is actually realized. In other words, the primary object of each of the various centres involved is not speech, but some other and simpler function; and speech arises from a union of such separate functions.

We accordingly find a development of consciousness keeping pace with the development of the physical organism. The extent of possible analogies between the growth of body and that of mind may thus be estimated from below; and any outstanding facts of the inner life which cannot be reduced to the form of physical analogy (if there be any such facts) get greater prominence and safer estimation.

The advocates of a spiritual theory of mind, therefore, should be quite ready to adopt this method, even from the standpoint of their traditional caution. Certainly they gain nothing by refusing to subject their high beliefs to the tests of conformity to the requirements of this law of the developing manifestation of the mental principle. The sphere of critical discussion will then be limited to places in the development of consciousness where spiritual implications force

themselves upon us. It certainly is as unscientific and unphilosophical to refuse to locate such points and to test such implications by the development hypothesis as it is, on the other hand, to claim a victory for the sensational interpretation of the hypothesis before all such points of apparent spiritual implication have been resolved. If the former attitude is arrogant, the latter is as certainly presumptuous.

4. In observing young children, a more direct application of the experimental method is possible.[1] By "experiment" here, I mean both external and internal experiment. In experimenting on adults great difficulties arise through the fact that re-actions are broken at the centre, and closed again by a conscious voluntary act. The subject hears a sound, identifies it, and presses a button. What goes on between the advent of the incoming nerve process and the discharge of the outgoing nerve process? Something, at any rate, which represents a brain process of great complexity. Now, any thing that fixes this sensori-motor connection or simplifies the central process, in so far gives greater certainty to the results. For this reason, experiments on reflex re-actions are valuable and decisive where similar experiments on voluntary re-actions are uncertain and of doubtful value. The fact that the child consciousness is relatively simple, and so offers a field for more fruitful experiment, has already been illustrated in what was said above as to the value of suggestion in child-life; it is also seen in the mechanical re-actions of an infant to strong stimuli, such as bright colors.[2] Of course, this is the point where originality may be exercised in the devising and executing of experiments. After the subject is a little better developed, new experimentation will be as difficult here as in the other sciences; but at present the simplest phenomena of child life and activity are open to the investigator.

With this inadequate review of the advantages of infant psychology, it is well also to point out the dangers of the abuse of such a branch of inquiry. Such dangers are real. The very simplicity which seems to characterize the life of the child is often extremely misleading, and misleading because the simplicity in question is not typical but idiosyncratic. Mr. Spencer had a large range of facts in view when he made organic development a progression not only in complexity, but also in definiteness; and the distinction between simplicity which indicates mere absence of complexity and that which indicates definiteness of function as well, applies with force to mental growth. Two nervous re-actions may appear equally simple; but one may be an adaptive re-action, and the other inadaptive. So a state of infant consciousness may seem to involve no complexity or integration, and yet turn out to represent, by reason of its very simplicity and definiteness, a mass of individual or race experience. In other words, children differ most remarkably in the early manifestations of their conscious lives. It is never safe, except under the qualification mentioned below, to say, "This child did, consequently all children must." The most we can usually say in observing single infants is, "This child did, consequently another child may." Yet the uncertainties of the case may be summed up and avoided if certain principles of mental development are kept in view.

[1] On the nature and application of experiment in psychology, see my Handbook of Psychology, Senses and Intellect, 2d ed., pp. 25-31.

[2] See the writer's note in Science, Oct. 31, 1890, p. 247.

(1) In the first place, we can fix no absolute time in the history of the mind at which a certain mental function takes its rise. The observations, now quite extensively recorded, and sometimes quoted as showing that the first year, or the second year, etc., brings such and such development, tend, on the contrary, to show that such divisions do not hold in any strict sense. Like any organic growth, the nervous system may develop faster under more favorable conditions, or more slowly under less favorable; and the growth of mental faculty is largely dependent upon such organic growth. Only in broad outline and by the widest generalization can such epochs be marked off at all.

(2) The possibility of the occurrence of a mental phenomenon must be distinguished from its necessity. The occurrence of a single clearly observed event is decisive only against the theory according to which its occurrence under the given conditions may not occur; that is, the cause of the event is proved not to lie among agencies or conditions which are absent. For example: the very early adaptive movements of the infant in receiving its food cannot be due to volition, but as to what may account for them the case is still open. It is well to emphasize the fact that one case may be decisive in overthrowing a theory, but the conditions are seldom simple enough to make it decisive in establishing a theory.

(3) It follows from the principle of growth itself that the order of development of the mental functions is constant, and normally free from idiosyncrasy: consequently the most fruitful observations of children are those which show that such a function was present before another could be observed. The complexity becomes finally so remarkable that there seems to be no before or after at all in mental things, and, if child processes show stages in which any element is clearly absent, we have at once light upon the law of growth. For example: if a single case is conclusively established of a child's drawing an inference before it begins to use words or significant vocal sounds, the one case is an good as a thousand to show that thought develops to a degree independently of spoken language.

(4) While the most direct results are acquired by systematic experiments with a given point in view, still general observations kept regularly, and carefully recorded, are important for the interpretation a great many such records may ultimately afford. In the multitude of experiences here, as everywhere, there is strength. Such observations should cover every thing about the child,—his movements, cries, impulses, sleep, dreams, personal preferences, muscular efforts, attempts at expression, etc.,—and should be recorded in a regular day-book at the time of occurrence. What is important and what is not, is, of course, something to be learned; and it is extremely desirable that any one contemplating such observations should acquaint himself beforehand with the principles of general psychology and physiology, especially the former. J. MARK BALDWIN.

THE INTERMARRIAGE OF THE DEAF, AND THEIR EDUCATION.

IN his valuable article on the above topic in *Science*, Nov. 28, Dr. E. M. Gallaudet erroneously states, that, in considering the intermarriage of the deaf, the "important fact has been overlooked . . . that with a large proportion of persons

commonly spoken of as 'deaf-mutes' there is no more likelihood of giving the legacy of deafness to offspring than with perfectly normal people." That fact was pressed in my article to which the doctor alludes, and, as he plainly shows, has been admitted by Dr. Bell. Dr. Bell's classification is doubtless the most philosophic of any yet promulgated, but whether it will be sustained by future investigations remains to be seen. Science is progressive because of the ascertainment of new truths. Its history shows us that the science of to-day may not be accepted as the science of to-morrow. It is too soon to predicate any positive theories upon the statistics as yet collected. The time during which they have been collated is too short, and their accuracy too unreliable (some being merely hypothetical, and many furnished by undiscriminating parties), to warrant deducing positive opinions from them, or the enunciation of any general law based upon them. The investigations of Dr. E. A. Fay, now in prosecution, will no doubt be of greater value than any preceding.

It is scarcely half a score of years since a really intelligent movement in this direction was inaugurated by Dr. Alexander Graham Bell, a philanthropist as well as an eminent scientist and inventor. Statistics relative to the deaf had been taken previously, to some extent, in several institutions, but the inquiries for them had not been general. Statistics, supposed to be reliable at the time of taking them, were by subsequent inquiries, which developed new or additional facts, materially changed; so that former deductions were necessarily reviewed and discarded. One man's lifetime is too short, and his observations too limited, to furnish data upon which to predicate the formulation of a general law. Dr. Bell may have discovered a law governing the offspring of the congenitally deaf persons, or he may have formed an assumption. I think there is as much evidence going to show that an inherent predisposition to deafness exists in some families (using this term in its extended sense), but that it expends its force in a particular line while it remains in others, as there is to show that it perpetuates itself from parent to child. Within my observation there have been more cases of deafness among children only one of whose parents was congenitally deaf than among those both of whose parents were congenitally deaf. I am not certain but that the percentage of the former would also be found less if careful investigation was made. Statistics could be so presented as to show that the intermarriage of the deaf tends to reduce the number of deaf children more effectually than for the congenitally deaf to marry the hearing, or persons whose deafness was acquired after birth, since by the latter means there is more probability of scattering the infirmity than there is in intensifying the predisposition to it by the former. It is undeniable that this predisposition is not obliterated by marriage with one who has it not: hence Dr. Gallaudet's ideal marriage of the congenitally deaf with the hearing, or Dr. Bell's suggestion that they marry the non-congenitally deaf, if there is any truth in the law of heredity, will most tend to increase the number of the deaf; because, where two persons in whom inheres the probability of having deaf offspring intermarry, there can result only one family of deaf children, whereas, if they marry hearing or non-congenitally deaf persons, two such families may result.

If the congenital deaf-mute must have so much solicitude for his offspring as Dr. Bell and Dr. Gallaudet insist on, shall the hearing person or the non-congenital deaf have none for his? The deaf man or woman has the same right to exercise his judgment in the selection of a partner for life that any other person has. If they desire to compare their family histories with reference to inherent predisposition to deafness, I know of no one who could object, or of no reason why they should not do so, and not as much as that they and all others should consider a phthisical, scrofulous, or cancerous family diathesis. Dr. Gallaudet's argument with reference to the marriage of the deaf with the hearing is good, but is quite as forceful on the other side of the question. Both parties to a marriage have an equal right to forecast the future. No one will deny that a family where one parent is deaf suffers greater disadvantage than one where both parents can hear. Unless there is sincere love between the parties, the hearing person will not enter into such a marriage. A question of this kind is not to be considered from the standpoint of the deaf alone.

After considering Dr. Gallaudet's objection, I still maintain, that, for those deaf persons who improve the opportunities afforded them under the genius of our civilization, deafness may properly be termed only a serious inconvenience. The term "misfortune" is indefinite, and may imply little or much. The loss of an arm is a misfortune, and so is the loss of a finger. I know of no one who says deafness is not a misfortune. My statement to which the doctor objects was to the effect that what was once a calamity (a very strong term) is now only a serious inconvenience. I suppose, as Dr. Gallaudet objects to this, that he uses the term "grave misfortune" in the sense of a calamity. It may or may not be such, according to circumstances. I have known instances in which the visitation of deafness proved to be a stroke of good fortune. I decidedly protest against forever holding up the deaf as victims of a terrible misfortune, and objects of commiseration and charity, after an intelligent public has, at enormous expense, made elaborate, and in some cases palatial, provision for their education, mental, moral, and manual, and while it continues a generous annual outlay for the prosecution of this good and necessary work; and especially do I object to impressing on the deaf themselves, as Dr. Gallaudet's article is calculated to do, that the time is never to come when they shall cease to belong to a special class who are to be looked after by others. I deem it wiser to instill into them the idea that they stand upon the same plane as others, and must provide for themselves as others do; and that, being handicapped with the inconvenience of deafness, they must expect to do a little better than others do in similar walks of life, and thus make themselves desirable to employers. I regard this as one of the important duties of a teacher of the deaf, and of none more emphatically than of one who stands at the head of a college for the deaf, where the choicest spirits and minds culled from a continent are assembled. Surely the public expects this, when the various States and the general government expend more than ten million dollars for buildings and grounds for the accommodation, comfort, and pleasure of the youthful deaf while securing their education, and annually expend a million and a half dollars for their instruction and maintenance. The traveller in European countries beholds palaces erected by public moneys for kings, princes, and prelates; but it is one of the crowning glories of America that our grand structures are mostly for humanitarian and educational purposes, which enlighten and elevate the common people. Prominent among these are some for the deaf, not to make them a pampered and favored class, but to fit them for an equal chance in life. In many cases this is done to such an extent that they distance their hearing relatives,

and, from being a dependence, they become the comfort and stay of aged parents and other needy relatives; so that I said I have known some instances where the visitation of deafness was a stroke of good fortune. When I see a lad, solely because of his deafness, taken by kind hands from a home of poverty; transported to an elegant institution where every want is anticipated, both in health and in sickness; for years clothed as comfortably and fed as healthfully as the children of opulence; favored with most skilful instructors and kind care-takers; given books and all school supplies; taught a good mechanical pursuit; graduated with honor; then taken to college, where for a term of years he is given a course of study as thorough as hearing persons receive and pay for in the best colleges; again graduated with honor; without a day's waiting or search inducted into a lucrative position and an honorable profession; having for these great benefits paid nothing, either himself or his relatives for him (and I consider, that, had he retained his hearing, a life of drudgery would as certainly have been his as it has been of the other members of his family),— I plainly see that deafness to him, though always a serious inconvenience, was a stroke of good fortune.

When I see the deaf daughter of a widow in poverty, after receiving her education, from her earnings purchase a home in which she maintains her mother, lends a helping hand to the other children, and lives for many years in the confidence and regard of refined people, I inquire, though always a serious inconvenience, where is the "grave misfortune" that deafness brought either to this lady or her friends, especially since older brothers and sisters do not half so much; and it is morally certain that she would not but for the excellent training she received because of her deafness. When a finely educated young man who never heard, tells me, in answer to my inquiry as to how much he laments his deafness, "Not at all," and adds in reply to further inquiries, "Because, so far as I can now see, had I been able to hear, I should have continued to live in the same low plane I was taken from, and in which my brothers, whom I dearly love, still live, but with whom I would not exchange conditions," though a serious inconvenience, I do not see in this visitation of deafness a calamity or even a "grave misfortune." When I see a lady congenitally deaf in her neat, tasty, well-kept, and well-ordered home, with walls decorated with drawings and paintings the work of her own skilful hands,— a happy mother, having on her lap a lovely child, which she is teaching to speak the utterances a devoted teacher years agone taught her,— and responding to the appeals of a hearing brother for financial aid to support his family, I inwardly ask myself, though always a serious inconvenience, where is the "grave misfortune" in the case of this person, whom I have repeatedly known to express thankfulness for her deafness in the days of her maidenhood?

A mother who had left with me child after child till four of her deaf children were under my care, once unburdened her heart to me, and complained bitterly of the hard Providence that had inflicted this calamity on her family, but added, "I have one son who hears: he is the apple of my eye and the pride of my life. I shall have great comfort in him." Years passed away. The deaf children completed their education, and were settled in life, when this same mother reminded me of the former conversation, and added, "I wish ——— had been deaf also: he has made me more trouble than all my deaf children together. If he had been deaf, he would have been under your training, as the others were, and would have been a good man." These are not hypothetical cases, but actual facts, to which there are many others similar. I doubt not all superintendents of institutions for the deaf have seen parallels. It may be urged that these and similar ones are exceptional cases. Grant that they are. All of them at the first were beset with very discouraging prospects. If, in spite of such unfavorable environments, these could rise superior to them, why should the deaf with more favorable conditions be taunted or tortured with the suggestion of grave misfortune? They do not seem so to regard one another. One would suppose that if sympathy for "a brother in distress" would anywhere call forth kindly reception and encouragement, it would be at a college where the subjects of "grave misfortune" are assembled. But to our surprise we find that these frolicsome lads "haze" the new-comers in a style that, while it might not do discredit to a Comanche Indian, certainly does no credit to themselves or their college.

There is a limit to the obligation society owes to its members who start at a disadvantage on the race of life, but just what the limit is has not yet been clearly defined. For the deaf, provision is made for ten years' care, keeping, and instruction by the State governments, and for a college course of from four to six years by the United States Government, to which it is now seriously proposed to add a normal school for the training of teachers. A home for the aged deaf has already been established in one section of the country, which is a most worthy enterprise, and is doing a very humane work. With the school and the college at one end of life, and the home at the other, it would seem that the limit must be nearly attained. But when the normal school is established, it is but a step further to provide an asylum where the intervening years of life may be passed, as is being arranged for the blind. That may be very well for the blind, but I would have no hesitation in denouncing any such project for the deaf as subversive of their best interest and manliness. No one, so far as I know, has seriously proposed such a provision for the deaf (though the inquiry has been made of me as to its practicability), but only a few years ago no one had proposed it for the blind. The tendency seems to be in that direction, and it is about time to call a halt. A "grave misfortune" can be used to plead for a large amount of charity.

Dr. Gallaudet adopts a common fallacy when he states that "all deaf children have the organs of speech." That they have the organ of voice is true, but voice is not speech. The organ of voice is one thing, the organ of hearing is another, but the organ of speech is the union of the two. Speech is the result of the intelligent combined use of the organ of voice and the organ of hearing in a healthy condition. Deaf-mutes have not the important organ of hearing, and, for this cause alone, have not speech. There is no speech of any race, tribe, or clan of men, however barbarous or cultured, that is not based upon hearing; so that we may say the organ of hearing is as essential for speech as the organ of voice. The two are the physical complements of each other in the production of speech. But there is a third element, not physical, necessary for speech; namely, intelligence. This the deaf-mute has perfectly. Nightingales, mocking-birds, and larks have voices that the sweetest and most renowned cantatrices have endeavored to rival in vain. Lions have voices that the basso of the grand opera has never approached. All these and many others of the lower animals have, in addition to voice, the sense of hearing more acute than has ever been known in man; but they have not intelligence sufficient to so use these gifts as to produce

speech. If it be urged that their vocal organs are not suited to formulate speech, I reply that idiots have perfect human organs of voice and hearing, but have not speech for the same reason that lower animals have not, — the want of intelligence. Not only are the organ of voice and the organ of hearing, with intelligence, necessary for speech, but they must be in a healthy condition, even to maintain perfect speech after it has been acquired. This is plainly shown by a fact noticed by every observant person, that individuals whose auditory apparatus becomes impaired (though the vocal chords remain in good condition) in middle life, after speech has been fully acquired, and possibly several languages mastered, suffer deterioration of their speech, despite the greatest watchfulness of themselves and their friend. Hearing is a constant monitor, correcting the errors of enunciation, as conscience is, correcting wrong impulses and acts. As surely as searing of the latter results in debasement of the moral life, so surely the failure of the former results in deterioration of speech. If it is difficult for one who once heard perfectly and spoke fluently to retain exactness of utterance with impaired hearing, how much more difficult it must be for one who never enjoyed the advantages of the hearing sense to acquire speech! Yet some do this to a limited degree; but they are marvels of ingenuity and perseverance on the part of their teachers as well as of themselves. It may be safely asserted that no more difficult task can be assigned to mortals than to effect this. To teachers it is a most exhaustive and death-dealing process, when followed up with cases not specially gifted with an unusual aptitude not readily accounted for. Such cases are rare and exceedingly interesting; much more rare than Dr. Gallaudet's admission that "all, or nearly all, deaf children can be taught to speak; but this is precisely as all, or nearly all, normal children can be taught to sing." This is not at all a just comparison, if the doctor means speech intelligible to general society. Congenitally deaf persons who readily use speech are more nearly analogous in number and production to good poets than to singers. "Poeta nascitur non fit" is a universally accepted adage, whose underlying principle may well be applied to good users of speech who never heard. These statements are made in a spirit of the utmost friendliness to the instruction of such deaf persons in articulation as can acquire it, and are willing to make the necessary effort to that end, and after more than twenty years of earnest labor in this work, in which I have seen more than one faithful teacher give up life as a martyr to it, and after placing a thousand pupils in classes for such instruction, and now having two hundred engaged in it. I have met some very gratifying results, but have experienced many disappointments. This was especially true in my first endeavors in articulation work, for I had not then learned that many deaf children who can easily be taught to utter elementary sounds, and associate them with letters, symbols, and diacritical marks, are completely frustrated when they come to use them in combination, and in the intricacies of continuous speech, with punctuation, intonation, and inflection, which give to speech for those who hear its musical quality and pleasurable effect, but of which the congenital deaf-mute has no conception. Speech in a monotone would be very insipid to those who hear, but for the deaf person it has not even a monotone.

Dr. Gallaudet's statements, in his excellent article upon the proper place for the sign-language in the education of the deaf, are so just and true, and the authorities he cites are so reliable and conclusive, as to leave no demand for further urging that point. But in *Science* of Oct. 17, Mr. B. Engelsman, speaking upon the nature of the sign language, so egregiously blunders in the statement that one is not able to express or receive abstract ideas through the medium of the sign-language, that I am forced to believe, upon the hypothesis that he is a truthful man, that he knows nothing about it, though the temerity of such a procedure, if not admirable, is certainly astounding. It may be safely assumed that two intelligent, well-educated persons, each having an accurate knowledge of two languages, will, in their daily intercourse with each other, use the one which best suits their purpose and expresses their thought with most precision. I now have in mind two gentlemen, one of whom lost his hearing at six years of age, the other at twelve. Each had good use of speech before becoming deaf, and has retained it. Both have received excellent educations, having mastered the literature of several languages, ancient and modern, and also the mathematics and metaphysics of a college course; yet in their daily association, which I have closely observed for years, they invariably use the sign-language, notwithstanding both would be considered good speakers for deaf persons. In answer to my inquiry, one of them says, "I do not use lip-reading or vocal utterance at all when I meet very well educated semi-mutes. I consider such a method a bore." The other of these gentlemen, in reply to the same inquiry, says, in view of his own experience, "Between two deaf persons, sign-making, interspersed with finger-spelling, is by far the easiest, readiest, and most satisfactory medium of conversation that man can devise. This mode of conversation is extremely delightful to me. I use in written conversation English, German, and French. By means of signs I can have a discourse addressed to me in philosophy, history, literature, science, theology, or any other topic, and can reproduce it very fully in writing." I know this to be true; for I have repeatedly known him to take notes of my unwritten addresses given in the sign-language, and afterwards furnish them for publication without the omission of a thought, and in better language than I could have expressed it myself, or than was in my mind at the time of delivery. I inquired of a deaf friend whose wife as well as himself has been taught articulation, and is a most acute lip-reader, how much they use speech and lip-reading together. His reply was, "In asking me if I habitually converse with my wife by means of lip-reading, you might as well ask me if we walk down town together on our hands. We do relatively as much lip-reading as that kind of walking." A very intelligent gentleman, living in the city of Chicago, whose wife as well as himself is a semi-mute, one having lost hearing at seven, the other at thirteen, years of age, and both while at the institution having received careful instruction in vocal utterance and lip reading, says, in answer to my inquiry, "Mrs. G. and I never carry on articulation with each other." He goes on to say, "As supplementary information, I may add, that, of the many semi-mutes in the city from the various schools of the country, only three of the whole number are known to use articulation as a sole and constant means of communication with hearing people." A lady congenitally deaf, who is unusually expert in the use of speech, whose husband is a semi-mute and speaks well, replies, "My husband and I use vocal utterance in our daily conversation a great deal, almost half as much as the sign-language. At meal-time we use our voices in such expressions as 'Please pass the bread,' 'Pass the butter, if you please,' etc., in short sentences; but when we talk at length, we have to use the sign-language, as it is quicker. I have

always felt so thankful for all you have done in teaching me to talk. It gives us great pleasure to talk to our precious little boy. He understands if I say 'Baby, don't,' when he pulls my hair. He can say 'papa,' is six months old, and weighs twenty pounds." This last is one of those exceptional cases, which we earnestly wish were more numerous among congenital deaf-mutes, that sometimes reward the long patient labor and ingenuity of the teacher. Among hundreds, I have found but few such. It will be noticed that even in this case, where there is both a disposition and an effort to make the most of her acquired speech, signs are necessary to supplement the best she can do with vocal utterance. I have refrained from an expression of opinion on this subject, preferring to give the testimony of persons who are unquestionably competent. The statements quoted were given without the knowledge of the use I should make of them. In view of such testimony, how any honest person can say that the sign-language is incapable of the expression of thought and abstract ideas is incomprehensible. I have never known an individual who endeavored to acquire this language to make such a statement. Even Mr. Engelsman, if he had witnessed at the Convention of American Instructors of the Deaf last summer, as many others did, the translation into the sign-language of the philosophical essay by Mrs. Alice Noyes Smith, simultaneously and concurrently with its reading by its author, would have pronounced it a marvel of exactness, force, and beauty. The sign-language is with that lady vernacular, as she was born and reared with the deaf. Added to this, she has enjoyed the training of her father, Dr. J. L. Noyes, superintendent of the Minnesota Institution for the Deaf, who is, I think, the one most discriminating, critical, and precise master of its language. Mrs. Smith stated that to her this language had all the ease, elegance, and force of spoken language.

In July, 1889, there assembled in the city of Paris, France, a world's congress of the deaf, to consider subjects relating to the welfare of their class, and take such action as might seem to be promotive thereof. This congress was the first of its kind. Its members comprised delegates from France, America, Belgium, England, Ireland, Australia, Sweden, Switzerland, Germany, Poland, and Turkey. They also represented all methods of instructing the deaf, in each of which some of them had received their education. If any company of persons could be expected to speak earnestly and frankly on subjects pertaining to the deaf, it would surely be such a one as this congress. The congress remained in session one week, discussing various questions pertaining to their class. At its conclusion the following preamble and resolutions were unanimously adopted: —

"Whereas the Milan Congress, sitting in solemn conclave, had decided that all deaf-mutes could be taught to speak, and that the pure oral system was superior to all others; whereas, under the influence excited by so august and important a body, changes have been made in some institutions which have a strong bearing on the immediate and future welfare of the deaf; whereas we, though we believe in the utility of the oral system to a certain extent, know that the conclusions arrived at by said congress are arbitrary and unwarranted by experience and facts: resolved, that the system known as the American combined system, which approves of the use of both articulation and signs as the only means by which the greatest number of the deaf can be reached, and the greatest amount of good done, is the best; that we deprecate all such arrangements as aim at the introduction of the oral system in its purest form, and the consequent exclusion of deaf-mute teachers, who have proved themselves fitted for the position; that the above be published to the world as the sentiments of the deaf-mutes gathered from all nations, in the congress held at Paris, July 11–18, 1889."

Such evidence as this is not to be lightly esteemed. It should be duly considered that *for* the deaf-mute there is no such thing as articulation, though there is articulation *by* the deaf; for, while he may utter distinct articulate sounds for others to receive, he cannot receive them himself, and is consequently thrown back upon the visible movements of the superficial parts of the organs of voice, which are chiefly the lips. Some mouths are so constructed that many of the movements of the tongue and teeth can also be perceived, but this is by no means frequently the case: hence what is so often spoken of as articulation, and is really such to the hearing, is only a lip-sign to the deaf; and there arises the question, which is better,— the small indistinct signs formed by the lips, which represent nothing but sounds, which have no existence for the deaf, or the large, rapid, concise, and ideographic signs made by the hands and arms? Which the preference of the deaf is, need not be asked; for it is universally the fact, and notorious, that deaf-mutes who have been taught by the lip method, and have been shielded from the "contaminating influence of signs" (!) more closely than they have from disease, when opportunity offers, take to signs as naturally as ducklets to the water. They are usually such adepts in the sign-language, that it is obvious to the discriminating observer that they are "old hands at the bellows." It would be as sensible to tell a rustic to blear his eyes on Broadway, or a boy to blear his at the circus, or a belle to wear dark goggles in a millinery-store, as to inhibit the deaf-mute using signs when he meets other deaf-mutes, if he has something to narrate. When fish will not swim in the water, and birds will not fly in the air, we may expect the deaf-mute to disuse signs as a means of interchange of thought. These statements are not made because of objection or opposition to teaching deaf-mutes to articulate or to read lip signs, for to some of them this ability is at times very useful. I have one of the largest companies of deaf-mutes in the world, receiving such instruction, and I purpose maintaining it in the future as I have done for more than twenty years, during which time I have assigned a thousand of them to teachers for such training. These facts are here set forth that justice may be done the deaf, of whom complaint is often made that they do not do better, by persons who fail to duly appreciate the difficulties they encounter. It should not be a wonder that they do no better, but that they do so well.

PHILIP G. GILLETT.

NOTES AND NEWS.

Symons's Meteorological Magazine for November contains a climatological table for the British Empire for 1889. The highest temperature in the shade was 109°, at Adelaide, on Jan. 13. For five years Adelaide has recorded the highest temperature in the shade, reaching 112.4° in 1886. It had also the highest temperature in the sun, 170.7°, and was the driest station during the year, having a mean humidity of 63 per cent. The lowest shade temperature was recorded at Winnipeg, on Feb. 23,— 42.6°. Only once does any other station come within twenty degrees of it. It had also the greatest range in the year, the greatest mean daily range (24.5°), the lowest mean temperature, and the least rainfall (14.95 inches). The highest mean temperature was 80.5°, at Bombay; and the greatest rainfall, 73.79 inches, at Trinidad. London was the most cloudy and the dampest station, the mean humidity being 81 per cent. The brightest station was Malta, which had little more than half the cloud of London.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

Vol. XVI. NEW YORK, December 26, 1890. No. 412.

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LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Deaf-Mutes.

I cannot agree with Dr. Gillett that it is not a very great calamity to have a deaf and dumb child. Still less can I agree with him that the deafness is no calamity to the child, but "only a serious inconvenience," as baldness is an inconvenience "in fly-time or cold weather" (*Science*, Oct. 31, p 249).

President Gallaudet dissents from such a view (*Science*, Nov. 28, p. 295), and the deaf themselves will surely not indorse it. The American public also, by their appropriations in aid of schools for the deaf, have expressed a very different opinion. The average *per capita* granted for the education of hearing children is less than twenty dollars per annum, whereas in the case of the deaf it exceeds two hundred dollars

Dr. Gillett says (*Science*, Oct. 31, p 248), "Not two per cent of the deaf and dumb are the children of deaf parents." But, if the percentage comes anywhere near that figure, the education of these children alone would cost about one million of dollars. The number of deaf-mutes reported in the census of 1880 was 33,878, and two per cent of this number is 677. At $200 a head, the cost of education would be $135,400 per annum, or $1,083,200 if instruction were continued for eight years.

"Two per cent" may seem a very small matter to unreflective minds, but a little consideration will dispel the illusion. Not one per cent, not even one in a thousand, of the general population, is deaf and dumb. In 1880 the percentage was 0 0675: in other words, there were 675 deaf-mutes to every million of the population. Dr Gillett's "two per cent" means 20,000 to the million, a proportion nearly thirty times as great.

Nor must it be forgotten that Dr. Gillett's percentage is taken upon the whole of the deaf-mute population (which, of course, includes children and unmarried adults), whereas the deaf offspring are the products of the married couples alone.

Indeed, as President Gallaudet points out (*Science*, Nov. 28, p. 295), they are chiefly the offspring of couples in which one or both of the parties were born deaf, or came from families containing more than one deaf-mute. Sporadic deafness (if not congenital) is rarely inherited, and the majority of the marriages of the deaf are free from deaf offspring. How prolific of deaf offspring the remaining marriages must be, if their children alone constitute a percentage of the whole deaf-mute population nearly thirty times as great as the normal percentage for the country!

Dr. Gillett informs us (*Facts and Opinions*, pp. 53–58), that, of 1,886 deaf-mutes who had been admitted to his institution, 293 were known to have married (his statistics included the children then in school). Of this number, 272, or more than 92 per cent, married deaf-mutes; and 21, or less than 8 per cent, married hearing persons. We are not told how many families were formed by these pupils; but, as we know that in the vast majority of cases deaf-mutes choose partners who were educated in the same school with themselves, we may safely infer that the families formed by these pupils were very much less in number than the figures would at first sight indicate. If none of these deaf-mutes married pupils of other schools, then the 272 cases alluded to above formed only 136 families. The true number, however, is probably somewhat greater.

Dr Gillett says (*Facts and Opinions*, p. 57), "These marriages have been as fruitful in offspring as the average of marriages in society at large, some of them resulting in large families of children. It is interesting to know that among all these only sixteen have deaf-mute children." He seems to be unconscious of the fact, that, if you take an equal number of marriages of hearing people, there should not be one deaf child among the offspring (in 1880 there was one deaf-mute for every 1,480 of the general population).

"Only sixteen,"—this expression unfortunately is ambiguous. Does he mean that there were only sixteen deaf children, or did only sixteen of his pupils have deaf children, or were only sixteen of the families formed by the pupils productive of deaf offspring?

In this latter case, how many families were there,—272, or 136?—and how many deaf children? And what percentage of the offspring were deaf, and what hearing? All he tells us concerning this important point is, "In some of the families having a deaf child there are other children who hear."

We are not told in how many of these cases the parents were born deaf, or belonged to families containing more than one deaf-mute, nor how many of the marriages included a congenitally deaf partner.

What I, as a student of heredity, would specially like to know is this: what percentage of the children were deaf in those cases where the married partners were both deaf from birth, and in those cases where both had deaf relatives? I am sure, that if Dr. Gillett will make the calculation, and apply the results to the deaf population of the country, he will realize, as I do, that the question of intermarriage is one that deserves more serious consideration than he has given it in his letter to *Science*.

While, on the one hand, Dr. Gillett does not think it matters much to a child whether he is born deaf or hearing, because "deafness is neither a crime nor a disgrace, nor entails suffering," and because it is so little of a calamity as to be "only a serious inconvenience," like baldness in fly-time, on the other hand, he advocates the intermarriage of deaf-mutes without regard to heredity, because deafness is so great a calamity as to cut them off from

almost every thing in life worth living for — excepting marriage with one another. "Shut out" he says, "from church privileges, as preaching of the Word, prayer-meetings, socials, receptions, lectures, concerts, parties, what remains to them of all that makes life pleasurable to us? . . . To forbid them, as some would, matrimony, the one remaining but most helpful and enjoyable of all social and family relations, is a monstrous cruelty with very little reason" (*Science*, Oct. 31, p. 248).

But Dr. Gillett need not feel disturbed about this matter. Neither I, nor any one else, so far as I know, proposes to practise this cruelty upon the deaf. My position upon this subject is substantially that taken by President Gallaudet (*Science*, Nov. 28, p. 295). I thoroughly agree with him in all he has said concerning intermarriage, and thoroughly disagree with the rest of his article.

Dr. Gillett advocates intermarriage because the affliction is so great, and ignores heredity because it is so slight. President Gallaudet's position is, I think, equally inconsistent. He advocates a certain system of education, while at the same time he deprecates its results. Segregatiom and the sign-language are the chief causes that have led to the intermarriages of the deaf and dumb. He advocates the causes, while he deplores the result. I may have more to say upon this subject at some future time.

ALEXANDER GRAHAM BELL.

Beinn Bhreagh, C.B., Dec. 10.

The Geology of Quebec City.

IN reference to the geology of Quebec, I can only say that practically the discussion of the citadel rocks has at present passed into the hands of the paleontologist. There is nothing conclusive in the stratigraphy of the region itself to show their exact horizon. They are bounded on all sides by faults of great extent, by which they are brought into contact with rocks of Sillery (Upper Cambrian) age on the mainland above Quebec City, with rocks of Levis (Lower Silurian) age at the west end of the Island of Orleans, and with the typical Hudson River rocks to the north of the city. The equivalents of the citadel rocks, as seen on the south side of the St. Lawrence River on Gaspé peninsula (see "Report of the Geological Survey," 1881–82), are, by a fault, brought in contact with Sillery rocks also; and the limited outcrops of these at Etchemin, on Crane Island, and at several other points, show a precisely similar arrangement.

The principal stratigraphical evidence bearing on the age of these rocks of Quebec City must, then, I take it, be looked for elsewhere. In the southern part of the province about Lake Memphremagog, graphitic shales containing graptolites, described by Lapworth as similar to those from Quebec City, also occur. These are in connection with certain gray and blackish slates and limestones which are an integral part, in so far as we can determine, of the series of slates and limestones which have been already described as Lower Trenton, or possibly Upper Chazy. The statement in Lapworth's paper, published in the "Transactions of the Royal Society of Canada," pp. 171 and 175, seems to be very clearly confirmed; and, from all the evidence at present in our possession, I can see no reason for changing the statement made in my report on this section ("Geological Survey Report," 1887–88, pp. 83, 84, K); viz., that these rocks represent a peculiar development of strata of Trenton age, and probably even down in that formation.

R. W. ELLS.

Ottawa, Dec. 16.

REFERRING to the article on the above subject in your issue of Dec. 5, I may say that Mr. Ami should have restricted his observation to paleontological facts; and the appropriate heading would have been, "On the Paleontology," etc., not "On the Geology of Quebec." As it stands, the article is an instance of what I have elsewhere designated "paleontological stratigraphy."

I was, I believe, the first to point out in 1876–77, and purely on stratigraphical evidence, the fact that the rocks of Quebec City were not, as mapped by Sir William Logan, Levis, but that they were certainly the extension of those on the north shore of Orleans Island, described on p. 200 of the "Geology of Canada" (1863) as Hudson River, and contain certain fossils, figured and described on the same page. I at the same time, 1877–78, traced out, and delineated on the map, the approximate course of the fault which cuts off the Levis formation, with its characteristic fauna, from the north side of the river. At that time no fossils had been found in the rocks of Quebec City, though mapped as part of the Levis formation (see *Geology of Canada*, 1863, p. 200); but, having determined by close and careful stratigraphical observation what these rocks were, I sent our collector, Mr. Weston, to Quebec to seek for the fossils, which I felt confident must be there, I told him, and that they would prove to be the same as those of Orleans Island, north shore. As Mr. Ami states, some forty or fifty species have since been found by Mr. Weston and others in these rocks. Some of them are from conglomerate bands, and therefore, like some of those in the Levis conglomerates, may be derived from older strata. Mr. Ami says these strata cannot be referred to the Lorraine nor to the Utica, but he fails to give any sufficient reason for this positive assertion. He then states Sir William Logan's opinion, but does not state mine, though he admits, without saying by whom it was determined, the equivalency of the shales on the north shore of the Island of Orleans with the Quebec City rocks. He still wants to separate the rocks at Montmorency Falls, which he, following Logan and myself, now recognizes as Utica, Hudson, or above the Trenton. The structure is diagrammatically shown in my section (*Descriptive Sketch*, p. 14) and in Logan's section (*Geology of Canada*, 1863, p. 234). The two sections are practically alike, and I believe are in a general sense correct. There is not a particle of stratigraphical evidence of any break between Montmorency and the Island of Orleans; but there is much folding, the result probably of the faults 1 and 2,— a slide down and a shove up respectively (see Fig. 1 in *Descriptive Sketch*). Mr. Ami's contention is based solely on his own determination of certain very imperfect specimens of fossils. These determinations may or may not be correct. They do not agree with Logan's (*Geology of Canada*, 1863, p. 200). Ami omits from his list *Graptolithus bicornis*, *pristis*, and *ramosus*, stated to be Utica-Hudson species (I believe these do occur in Mr. Ami's lists, but under new names). But, even suppose Mr. Ami's determination to be correct, it would not in the least change my opinion as regards the position, in what we call the Cambro-Silurian system, of these rocks; viz., that they constitute a part of the great Calcareo bituminous shale formation which overlies the Trenton limestone, and which is known as Utica and Hudson, or Utica-Lorraine, or Cincinnati group, and which has nowhere, from the Lower St. Lawrence to Lake Superior and Wisconsin, ever been seen beneath the Trenton.

I cannot see my way to construct a map or a section, having regard to the known stratigraphical facts, which would bring the Quebec City rocks below the Trenton; nor do the fossils (see lists in *Annual Report of the Geological Survey of Canada*, vol. iii. part 2, pp. 77 K to 81 K) seem to point in that direction, such as *Asaphus* (Canadense?), *Trinucleus*, *Leptœna sericea*, and the graptolites above named (*bicornis*, *pristis*, and *ramosus*). I see no reason for Mr. Ami's remarks about the name "Hudson River," or that there ever was any confusion in its use. The name and the equivalent terms — Lorraine or Cincinnati — are well known, and have always been applied to formations above, or supposed to be above, the Trenton, and below the Medina. The only confusion has been in defining the areas occupied by these formations.

There are, in connection with the old Quebec group area from Vermont to Cape Rosier, still a few doubtful points: 1. The question whether the rocks of Cape Diamond and Quebec City are above or below the Trenton limestone, i.e., Utica, Hudson, or Chazy; 2. The question whether the group of strata originally designated by Logan as "The Magnesian Belt," and by myself as the "Volcanic Group," which include the serpentines, with asbestos and other altered igneous rocks, are Upper Archæan or Lower Cambrian. No fossils have yet been found in any of the strata of this group; but from other considerations, physical, lithological, and stratigraphical, I am inclined to think they are pre-Cambrian, and about the age of the upper part of what we designate "Huronian" in the Lake Superior region.

ALFRED R. C. SELWYN.

Ottawa, Can., Dec. 16.

Study of the Surface-Markings of the Planets in 1890.

The progress of astronomy during the year 1890 has been noteworthy in many ways. Some of the important particulars will be given briefly in the references that follow.

The study of the surface-markings of the planets has had a leading place in the work of astronomers giving special attention to observation of this kind. The most startling announcements that have appeared this year are those made by the distinguished Schiaparelli of Milan, Italy, concerning the rotation periods of the planets Mercury and Venus. The first publication of this wonderful discovery, that we know of, was made Dec. 8, 1889, in a public address by Schiaparelli, before the Accademia dei Lincei of Rome, in a special sitting, attended by the King and Queen of Italy.

The discovery was by no means accidental. It was made in the usual way of determining the rotation time of a planet, and that was by observing spots on the surface; and the conclusion reached is, that the rotation time of the planet Mercury is the same as its period of revolution around the sun, its axis being nearly perpendicular to the plane of its orbit. The markings were faint, said to be exceedingly difficult to observe, and Schiaparelli has also found the same thing to be true in regard to the rotation of the planet Venus.

M. Perrotin, director of the observatory at Nice, made a series of observations on the markings of the planet Venus for seventy-four days between May and October, for the purpose of testing for himself Schiaparelli's results. His conclusion is, that the rotation time of the planet Venus does not differ from the time of revolution around the sun more than thirty days, making its time of rotation somewhere between one hundred and ninety-five and two hundred and twenty-five days. He also finds that the axis of the planet is almost perpendicular to the plane of its orbit. The displacement of the white region, observed at the northern edge of the terminator, indicates a difference not to exceed fifteen degrees, as was admitted by Schiaparelli. This important work materially strengthens the views of Schiaparelli.

Coming nearer home in our study of the surface-markings of the planets, it should be mentioned that the change of latitude, or the variation of latitude on the earth's surface, should be mentioned as a question of much interest in scientific periodicals for the year 1890. Significant and unexplained results are found in the records of some of the oldest observatories in the world that indicate a change in latitude.

At a meeting some time ago, the International Geodetic Association discussed this important question; and at another soon to be held, if deemed wise, plans will be made to undertake an extended series of observations by observatories in both hemispheres, for the purpose of determining whether or not the latitude of a place is constant, or a variable quantity. Professor Porro of the Royal University of Turin is much interested in pushing this work forward.

In this country the study of the markings of the planet Mars for the last year received as much, if not more, careful attention by Professor W. H. Pickering of Harvard College Observatory than by any one else. Although the last opposition was not a favorable one for the delicate and severe work required of one who can observe the "canal" system of Mars, it gives us pleasure to record what he did. His work was by photography at Mount Wilson, California, and by visual observation at Cambridge, Mass., using the Boyden 12-inch refractor.

His attention was directed to two points,— the colors exhibited by the planet, and the finer detail upon the surface. In regard to surface delineation, he thinks that Green's map gives much the best idea of the appearance of the planet, and the general shape of the details, of any thing yet published; and still his observations at Cambridge give considerable fine detail not shown on Green's map, all of which agrees more or less with that reported by Schiaparelli. Professor Pickering regards the name "canal" as a very unfortunate term by which to designate the strange surface-markings, because there is not the slightest evidence to support the supposition that they are filled with water: on the contrary, such a view is a very improbable one. Though he can see a large part of this surface delineation, he is not able to see the markings called "canals" double, as described by Schiaparelli. He deservedly expressed great admiration for the patient study and the keen eye of the astronomer who could discover details of Mars with an eight-inch telescope, because of the great difficulty of seeing them with larger instruments when their places and characters are known. During the present year Schiaparelli has reviewed his former work on the study of Mars' surface; and a report of the same appears, by Dr. F. Terby of the Academy of Belgium, in the November number of *L'Astronomie*. This late account of the work of the original discoverer is important, in that it confirms his former results, and adds to them interesting details in regard to the apparent widening of some of the canals and the apparent change of duplicity in the different parts of the same canals at different times. This report will be read with great interest, because it strongly confirms Schiaparelli's former views, which have been cautiously entertained by astronomers generally.

The most interesting work on the detailed study of Jupiter during the past year is by J. E. Keeler of the Lick Observatory. His drawings, made by the aid of the 36-inch equatorial during the months of July and October, are most excellent specimens of sharp delineation in variety of detail. The fine shading of the belts, the Great Red Spot in distinct outline, with the broken bands veering in latitude as they pass the spot, the round white spots, the oblong dark spots tinged with red at the bottom, and the satellite and its shadow in transit, are some of the very interesting features of Jupiter's surface-markings which Mr. Keeler has put on record in these drawings. The new features about the oval spots are their shape and red color at the base. By other observers they have been spoken of as round, and we do not recall that others have noticed the color which they all show at the bottom. This is doubtless due to the superior power of the Lick telescope. Taking into account the fact that Professor Young has seen a veiling of the Great Red Spot,— something like a white film over it, if we understand his words,— and the views of Mr. Keeler shown in his drawings, where the dense dark clouds are bent about it as they pass it, and something of the same color as that of the Great Spot seen at the base of the dark oval spots on the other side of Jupiter's equator, it seems as if signs of important changes in the surface character of the giant planet are constantly going on before our eyes from year to year.

We are sorry that Mr. Keeler's fine drawings have not been published in this country. They have nearly all appeared in foreign scientific journals. Wm. W. Payne.

Carleton College Observatory, Dec. 16.

Snake Hill, N.J., as a Locality for Minerals.

Being told that there had been some crystals found at Snake Hill, N.J., early in 1888 I started out, accompanied by a young mineralogist, and traversed a road leading across a marsh to the hill, for a distance of five miles. We sought out the quarry where the convicts from Hudson County are educated in the art of blasting. It is about a hundred feet high, and overlooks the Hackensack River.

The hill is an ejection of trap, surrounded by sandstone, the rock being used in macadamizing the county roads. We found several veins of minerals running across the quarry.

The principal minerals which we found and classified are datholite in fine glassy crystals; pectolite in long aggregations of crystals, some exceeding three inches in length and in fibrous radiations; laumonite in fine, needle-like crystals; prehnite in small balls of a beautiful green color; natrolite in fine glassy aggregations of fibrous crystals; analcite in excellent trapezohedrons, some of which measured nearly one inch across; apophyllite in fine transparent square octahedrons, prisms, and tables; gmelinite in excellent aggregations of pink crystals, rhombohedral in form, and modifications of the same, some of which were three-quarters of an inch across; stilbite in prismatic crystals and acicular aggregations of brown and white color; heulandite in brownish rhomboidal crystals; calcite, massive, of white, yellow, and green colors, and dog-tooth crystals of yellow color. There were many

other crystals and massive specimens found, but either very small or insignificant in regard to quality or quantity.

I expect this place to be to the mineralogist what its near neighbor, Bergen Hill, world-famed, was fifteen years ago.

E. W. PERRY.

Color-Changes in Toads.

IN Mr. Poulton's "Colors of Animals" he mentions (p. 83) that "the common frog can change its tints to a considerable extent." This recalls some experiments made in 1876 on common toads. Toads kept on dark grounds or in dark pen became dark, and on light grounds or in light pen became very much lighter in color. The arrangement of colors was not changed, but the whole seemed to grow lighter or darker. Red, blue, or other colors seemed to have no effect except as to their value as light-absorbers. Owing to the detailed notes being mislaid at this writing, it is impossible to give details of time; but my remembrance is that the change of shade took much longer than Mr. Poulton quotes for the frog. The experiment is an easy and interesting one to try. In fact, there is an immense field for young investigators in the question of color, because of the ease with which apparatus can be arranged and the number of species which as yet have not been tested. It is partly for this reason I record the above on toads.

FREDERIC GARDNER, JUN.

Trinity College, Hartford, Conn., Dec. 17.

The Cause of Rain.

IN your issue of March 7, I refer, on p. 161, in a letter with the above title, to certain experiments which to my mind show conclusively that condensation takes place in saturated air by compression, and not by expansion.

As far as I am able to ascertain, the rain theories which my letter brings me in opposition to are based upon the supposition that the results of compressing and expanding saturated vapor or steam, as mentioned in the mechanical theory of heat, may be directly applied to saturated air.

That these two so entirely different substances — the one a pure gas, and the other a compound or mixture of various gases, and both containing the same quantity of aqueous vapor for equal temperatures, pressures, and volumes — should act in the same way under compression and expansion seems to me hardly credible, and it may therefore be of interest to inquire whether any of your readers can quote the results of experiments on saturated air which are contrary to those I have arrived at.

FRANZ A. VELSCHOW, C.E.

Brooklyn, N.Y., Dec. 20.

BOOK-REVIEWS.

A Treatise on Electro-Metallurgy. By WALTER G. MCMILLAN. London, Charles Griffin & Co.; Philadelphia, J. B. Lippincott Company. 12°. $3.50.

THIS volume treats of the application of electrolysis to the plating, depositing, smelting, and refining of metals, and to the reproduction of printing surfaces and art work, etc. That the author was well equipped for his work is evident to all who, with some understanding of the subject, glance through even a single chapter of the book. He believes evidently that in writing upon such subjects a technological rather than a technical treatment is required, for the matter is so lucidly set before the reader, that, even though he be a novice, he will have no difficulty in comprehending; and this result is achieved without the use of technicalities, which, though useful in their proper place, are sometimes confusing to the general reader, and unnecessary for the expert. Still, in cases where the success or failure of a process is largely governed by strict attention to minute details, the author has not hesitated to introduce such instructions as may be needful to guide the worker in the right direction. In other words, the treatise is just such a combination of theory and practice as might be expected from one who, in addition to a knowledge of both sides of the subject, possessed the happy faculty of imparting that knowledge to others, as far as may be done through the medium of a book.

The first chapter is mainly historical, briefly sketching the progress of the art, from the rude beginnings of its chemical side, when it was discovered by the ancients that "certain metals became superficially coated with other metals when plunged into suitable solutions," down to its latest developments, not omitting the much-discussed Elmore process of producing seamless copper tubes. In this chapter the scope of the art of electro metallurgy is stated to be, (1) to obtain a coherent and removable deposit on a mould the form of which it is desired to reproduce with accuracy,—electrotyping; (2) to obtain a thin but perfect and adhesive film of metal upon a metal of different character, in order to impart to it properties in which it is naturally deficient, — electroplating; (3) to obtain the whole of a given metal from a substance containing it, either as a substitute for extraction by smelting, or for analytical or refining purposes; and (4) to dissolve metals, — either to remove an existing coat of one metal from the surface of another, or to effect the complete or partial solution of a homogeneous body superficially, as in electro-etching. This statement will give a good idea of the scope of the treatise.

As a fair knowledge of chemistry and electricity is necessary to those who would understand the subject, the author introduces a chapter dealing in an elementary fashion with those sciences; not intended, of course, to take the place of text-book and laboratory study, but rather to lead up to it. The book is fully illustrated, and, in addition to a good index, has a glossary of substances commonly employed in electro-metallurgy, and many useful tables.

Outings at Odd Times. By CHARLES C. ABBOTT, M.D. New York, Appleton. 16°. $1.50.

To those acquainted with Dr. Abbott's previous works, this little volume needs no introduction. In spirit, if not in bookmaking sequence, it is one of a series of which, we trust, the end is not yet. To the nature-loving naturalist, not the perfunctory one, the reading of it will necessarily be a pleasure and an assistance; to the city dweller, with an occasional "day off," at any season of the year, it will prove an incentive to recreation-seeking in the best direction; to the average dweller in the country it will act as an "eye-opener" to much that is going on about him; while to any reader of ordinary intelligence the perusal of it cannot fail to be beneficial. It is the record of what a true lover of nature, in all its phases, has seen, heard, felt, and thought about on occasional outings at odd times, in odd places, and under what may be called odd circumstances. Beginning with a winter sunrise, and the midwinter minstrelsy of the birds that may be heard along the Delaware even when the snow covers the ground, he carries the reader around the cycle of the seasons, dwelling upon the pleasures that may be indulged in out of doors at almost any time, and even in the most unpromising of places. Moreover, there is much sound though unobtrusive philosophy in the book.

Dust and its Dangers. By MITCHELL PRUDDEN, M.D. New York, Putnam. 16°. 75 cents.

DR. PRUDDEN'S interesting little volume, "The Story of the Bacteria," is followed by another of equal interest and value. It has been written "with the purpose of informing people, in simple language, what the real danger is of acquiring serious disease — especially consumption — by means of dust-laden air, and how this danger may be avoided." The plan is well carried out, and the book will open the eyes of the people without needlessly alarming them. Chief attention is given to the consideration of the organic — bacterial and mould — constituents of dust-laden air. The "plate method" of biological analysis of air — i.e., five minutes' exposure to the air of a film of nutrient gelatine, and subsequent growth of colonies from the germs deposited — is simple and reasonably accurate, and yields interesting results. The relative numbers of bacteria in the air of the library of a private house, of a large retail dry-goods store, and of a cross-street in process of being cleaned, were 34, 199, and 3,810. Under ordinary conditions, a New Yorker takes into his body with every twenty breaths 11 to 376 bacteria and moulds; and, when the dust is being stirred up, the number is excessive. The most of these are not disease-germs, but some may be so. Thanks to the ciliated cells of the air-passages, the phagocytes, the lymph-glands, and the digestive processes, the organic and inorganic dust-particles are

mostly well disposed of. But some of the germs may find the proper soil, multiply, and cause disease. Of such diseases, consumption is by far the most deadly, and the one most easily spread, since the germs are being constantly scattered in the sputum in streets, public buildings, and public conveyances. Consumption is, however, preventible, and to this end the destruction of the sputum would distinctly tend. The author's severe strictures of the street-cleaning department are fully justified. "We virtually condone manslaughter just as long as we permit men to hold municipal offices who fail in their plain duty in the protection of the public health."

Germ-laden dust readily finds its way into private rooms: hence, after sweeping, the furniture and floor should be cleaned, not dusted. "Dust and its Dangers" is an excellent, suggestive, and temperate little book.

AMONG THE PUBLISHERS.

Among the features of *Outing* for January, 1891, are "Artificial Skating Ponds," by C. Bowyer Vaux, who teaches our boys how nature can be "coached" into the skater's service; and "Sailing on Skates," and the method of rigging up such an outfit.

— The D Van Nostrand Company of this city have published, in a neat octavo of a hundred pages, a work on "Maximum Stresses under Concentrated Loads, treated Graphically," by Henry T. Eddy, C.E., Ph.D., professor of mathematics and civil engineering in the University of Cincinnati. It is a reprint from the "Transactions of the American Society of Civil Engineers," and is illustrated by twenty-five figures in the text and one folding plate. The object of the work, as stated by the author, is to introduce a new graphical method for determining what position a moving train of wheel weights must have in order to produce the greatest stress in any given part of the bridge truss or girder over which the train is passing. The method proposed depends principally upon the construction and use of a class of polygons or curves named by the author "re-action polygons." These are readily constructed graphically, and their properties are such as to give with ease the train positions for maximum stresses as well as to decide which one of several maxima is the greatest. The proof of these constructions is given in algebraic form, the graphical constructions being really only representations of the algebraic conditions for maximum stresses. The treatise shows how the algebraic theory leads to convenient graphical solutions of the equations of condition for maximum stresses, and will prove a serviceable addition to the growing literature of bridge engineering.

— In *The Chautauquan* for January, 1891, may be found "The Intellectual Development of the English People," by Edward A. Freeman; "The English Constitution," IV., by Woodrow Wilson; "England after the Norman Conquest," Part I., by Sarah Orne Jewett; "The English Towns," by Augustus I. Jessopp, D.D.; "Studies in Astronomy," IV., by Garrett P. Serviss; "How the People are Counted," by H. C. Adams; and "Plants in Legends," by Dr. Ferd.

— The American Book Company have just published "Greek for Beginners," by Edward G. Coy, professor of Greek in Phillips Academy. It is intended to be a companion book to the Hadley-Allen "Greek Grammar," and to be used as an introduction to either Coy's "First Greek Reader" or the Anabasis of Xenophon. A book bearing the same title, prepared by Professor Joseph B. Mayor, was published in London in 1869. An American edition of that book, considerably altered in form, was published in 1880 as "Coy's Mayor's Greek Lessons." The book now issued is a revision of the last-named edition, but the changes introduced by Professor Coy are so numerous and extensive, that, in justice to both Professor Mayor and himself, he has deemed it advisable to assume the entire responsibility for the work. He has therefore

dropped Professor Mayor's name from the titlepage, although acknowledging his indebtedness to that gentleman's book. The distinctive features of the work as now presented consist in its "building-up a boy's knowledge of Greek upon the foundation of his knowledge of English and Latin," and in the fact that "no Greek words have been used in the earlier part of the book except such as have connections either in English or Latin."

—Among the recent publications received from the United States Coast and Geodetic Survey Office is "Appendix No. 8, Report for 1888 (90 pp. sketch), entitled Geodesy. Geographical Positions in the State of Connecticut. Prepared for publication by Charles A. Schott, assistant." This collection of geographical positions, and of geodetic data resulting, is made in continuation of the scheme of publishing the results in those States where the field-work of the triangulation is substantially completed, and where the triangulation could be made to rest on the standard data of the survey.

—An interesting paper by Professor von Hofmann, upon the dissociation of carbon dioxide gas into carbon monoxide and oxygen by means of the electric spark, is referred to in *Nature* of Dec. 4. Dalton and Henry long ago showed that carbon dioxide, although formed by exploding a mixture of two volumes of carbon monoxide with one volume of oxygen by the passage of an electric spark, is again partially decomposed into carbon monoxide and oxygen by the continued passage of the spark. This dissociation, however, is very slow, and usually incomplete. Hofmann and Buff, in the course of their well-known work upon gaseous re-actions, further showed that "the electric spark passes through carbon dioxide with a violet glow, producing at first a rapid increase in the volume, which, however, becomes less and less marked until at the expiration of about half an hour the separated carbon monoxide and oxygen recombine with a sudden explosion, the re-formed carbon dioxide at once commencing to be again dissociated." Deville and Berthelot afterwards investigated the same phenomena, and also found that the re-action was never complete, proceeding only until about 28 or 29 per cent of the carbon dioxide was decomposed, but they never observed any explosive recombination as described by Hofmann and Buff. Professor Hofmann has therefore determined the exact conditions under which the explosive recombination occurs. It certainly appears somewhat remarkable that the same spark can effect both dissociation and recombination; yet such, within the limits described in the memoir, is an actual fact. The first essential point to be observed is the length of path of the spark. The most suitable distance apart of the platinum terminals appears to be between two and a half and three millimetres, and Professor Hofmann advises the use of adjustable terminals rather than the ordinary platinum wires fused into the side of the eudiometer. A Leyden jar in the circuit renders the occurrence of periodical explosions more certain. The spark should also pass at about a quarter the height of the gas column, instead of, as usual, near the top. The current itself, moreover, should not be too strong: that from two Bunsen cells and only a moderate sized Ruhmkorff coil is quite sufficient, and yields the best results. It is also preferable to use a volume of carbon dioxide, previously dried over oil of vitriol, not exceeding ten cubic centimetres at a pressure of 650–700 millimetres: eight cubic centimetres give excellent results. Under these conditions, the first explosion usually occurs in from fifteen to twenty minutes, and sometimes earlier. The flame commences in the neighborhood of the spark, and then perceptibly spreads through the whole length of the gas column. It is colored blue in the first explosion, and green in the succeeding ones, owing to the volatilization of a little mercury vapor. The second and succeeding explosions occur after shorter intervals than the first. This experiment is certainly one of the most interesting in all the range of dissociation phenomena; and full details, with drawings of the apparatus, are given by Professor Hofmann in his memoir.

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

Dec. 20.—Annual Reports of the Treasurer and Secretaries, and election of officers for the year 1891.

The Anthropological Society, Washington.

Dec. 16 —Robert Fletcher, The Vigor and Expressiveness of Older English.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—A young man wishes a position as instructor in the sciences in some school or college. Chemistry a specialty. Would like to hear of some position with a private or manufacturing chemist, in which his knowledge of chemistry would help him. Address E. E. TOWNE, B.A., 272 Worthington St., Springfield, Mass.

WANTED.—An Exploring Expedition, backed by $15,000, will be sent into Alaska and the British Northwest Territory the coming year, to be gone one or two seasons. A scientist or two will more than likely be taken along. Applications from such will be gladly received and carefully considered. To assist in making these applications the commander would say that he considers a full practical knowledge of mineralogy and geology necessary, and if the applicant can add the duties of botanist, ethnologist, or any other of the sciences, and photography, sketching, medicine and surgery, or other useful arts for exploring; it will add to the chances of being selected. Applicants must be physically perfect, and ought to be about medium age. One of these scientists will be the second in command of the party. Any credentials forwarded for consideration will be returned, if requested, after consideration. Address "ALASKA," care of *Science*.

WANTED.—There being a considerable annual income for the purchase of books for the Museum Reference Library of Iowa College, it is desirable to have at hand any and all circulars, specimen sheets, catalogues, etc., of all works on Natural History in general, both foreign and domestic. Circulars of museum supplies, apparatus, etc., etc., desired also. State terms. Address ERWIN H. BARBOUR, Box 1333, Grinnell, Iowa.

WANTED.—A situation as Analytical Chemist is desired by the assistant of the late noted scientist, Dr. Cook, during his 15 years survey of the State of New Jersey. Highest testimonials furnished. Address Prof. EDWIN H. BOGARDUS, New Brunswick, P. O. Box 224, care Prof. F. C. Van Dyck.

COULD some one inform me what the ingredients and origin of asphalt as used for street-paving and gathered at Trinidad are? Also how gathered and shipped by natives, and mode of refining by the Warren-Scharf Co. of New York and the Barber Co. of Washington? G. KNIPER, 28 Gunn Block, Grand Rapids, Mich.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I wish to exchange Eastern *Lepidoptera* for those that I do not have, particularly those found in the South. Jos. F. Crandall, Honesdale, Wayne Co., Pa.

To exchange, 1890 Seeger and Guernsey Cyclopedia, containing a complete list of the manufactures and products of the U. S., and address of first hands, cost $6. David R. Lewis, Saybrook, Ill.

For exchange—Nice specimens of Unios alatus, trigonus, parvus, occidens, anadontoides gibbosus, rectus, verucosus, gracilis coccineus, ventricasus, multiplicatus and plicatus cornutus. Margaritana confrogosa, complanata, rugosa. Anadonta edentula, decora, corpulenta, and about 300 of the beautiful Ana. suborbiculata. Wanted: Unios from all parts of the world, and sea-shells. Address Dr. W. S. Strode, Bernadotte, Ill.

BOOKS: How to Exchange them for others. Send a postal to the SCIENCE exchange column (insertion free), stating briefly what you want to exchange. SCIENCE, 47 Lafayette Place New York.